This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

Chem 1608.61

The gift of
THE ESTATE OF
GEORGE EASTWOOD
HARVARD COLLEGE LIBRARY

SCIENCE CENTER LIBRARY

225 George Eastwood 18

LIQUID SOAP FOR CLEANING WOOL. An excellent liquid soap, for cleaning and washing raw wool, according to Moser, may be prepared by using a kettle in which the mass can be heated, by means of a steam tube opening directly into it. The kettle (holding 150 gallons) is first to be half filled with water, which is then to be heated, and 68 pounds of caustic soda of 42 B, and 125 pounds of oleine added to it. This soap is to be boiled thoroughly for twenty to thirty minutes with continued stirring, and is then ready for use, forming a very homogeneous, so-called, soap-glue, of a sirupy consistency, and especially adapted for washing wool. Should the soap be required for fulling, an addition of some ammoniacal salt will be of advantage, to be introeuced immediately before using. Instead of caustic soda, which it is sometimes difficult to obtain, we may use ordinary soda salt, which is to be rendered caustic by leaching through freshly burned and slightly moistened lime. Even ordinary potash lye, obtained from ashes, mixed with fresh quicklime, can be employed in this preparation.

Soluble glass for washing [illegible] Goods:

one part of [illegible] soluble glass to 40 parts of water at 135° F. In this solution [illegible] is to be immersed and turned about for [illegible] and then rinsed in cold water. The [illegible] [illegible]

Soluble Glass: May be prepared by various processes.
If Sand be used, 15 parts of fine Sand,
thoroughly incorporated with 8 parts of Carbonate of soda
or with 10 of Carbonate of potassa, and one of charcoal
fused in a furnace, to produce a silicated alkali
which is soluble in boiling water. obtained this silicated alkali
Messrs Ransome [illegible] in solution of Caustic
by dissolving [illegible] 300°.

Yours Truly
Richard Gibson

THE

ART OF DYEING

ALL COLORS ON

RAW COTTON OR COTTON WASTE,

FOR THE PURPOSE OF

WORKING WITH RAW WOOL:

ALSO

THE METHODS OF DYEING ALL COLORS IN THE PIECE.

IN TWO SECTIONS.

THE

SYSTEM AND SCIENCE OF COLORS,

OR THE

Principles and Practise of Woolen Dyeing.

THE

PROPERTIES AND COMPOSITION

OF THE

DYESTUFFS AND CHYMICAL COMPOUNDS

WHICH ENTER INTO THE

CONSTITUTION OF COLORS.

BY RICHARD GIBSON,

DYER.

THREE VOLUMES IN ONE.

WILLIMANTIC, CONN.:
JOSEPH ROLLINSON, AGENT.
1861

~~VII-1878~~

Crem 1600.61

From
the Estate of
George Eastwood.
Feb., 1887

Entered according to Act of Congress, in the year 1861,
By RICHARD GIBSON,
In the Clerk's Office of the District Court for the district of Connecticut.

PRESS OF
JOHN W. STEDMAN,
NORWICH, CONN.

THE ART OF DYEING
ALL COLORS ON RAW COTTON OR COTTON WASTE,
FOR THE
PURPOSE OF WORKING WITH RAW WOOL:
ALSO
THE METHODS OF DYEING ALL COLORS IN THE PIECE.
IN TWO SECTIONS.

TABLE OF CONTENTS TO SECTION FIRST.

Introduction, ... xi
General Observations on Dyeing Raw Cotton and Cotton Waste, ... 9
Description of the Dye-House, ... 14
Particular Directions for Dyeing, ... 18
Treatment of the Cotton in the Dyeing Operations, ... 19
The Recipes or Formula for Colors, ... 21
Systematic Arrangement of Colors, according to their Natural Order, ... 23
Black, Recipes for, ... 24
Olive, Recipes for, ... 28
Brown, Recipes for, ... 32
Green, Recipes for, ... 38
Purple, Recipes for, ... 41
Blue, Recipes for, ... 42
Red, ... 46
Aurora, ... 47
Yellow, Recipes, for, ... 50
Minor Shades of Positive Colors, ... 54
Minor Shades of Black, ... 55
Minor Shades of Olive, ... 57
Drabs, Recipes for, ... 57
Minor Shades of Brown, ... 59
Fawns, Buffs, &c., Recipes for, ... 59

Treatment of the Colors after Dyeing, ... 63
Concluding Observations, ... 66
Explanations of Technical Terms, ... 68

TABLE OF CONTENTS TO SECTION SECOND.

The Advantages of Piece Dyeing, ... 73
Obstacles to Dyeing in the Piece, ... 74
The Dye-House, ... 77
General Directions for Dyeing, ... 78
The Recipes, ... 80
Black, Remarks on, ... 82
Black, Recipes for, ... 82
Plum or Corbeau, ... 91
Olive, Recipes for, ... 94
Brown, Recipes for, ... 99
Green, Recipes for, ... 105
Purple, Recipes for, ... 110
Lavender, ... 112
Blue, Recipes for, ... 113
Aurora, Red and Yellow, Remarks on, ... 119
Minor Shades of Black, Recipes for, ... 122
Minor Shades of Olive, Recipes for, ... 127
Minor Shades of Brown, Recipes for, ... 133
The Epitome of Dyeing Cotton and Wool Cloths, ... 136

THE

SYSTEM AND SCIENCE OF COLORS,

OR THE

PRINCIPLES AND PRACTISE OF WOOLEN DYEING.

TABLE OF CONTENTS.

Preface, ... 145
Construction of a Dye-house, ... 148
Theory and Practise of Wool Scouring, ... 158
Manual Operation of Dyeing, ... 164
Treatment of the Dyestuffs in the Kettle, ... 166
Different Modes and Processes of Dyeing, ... 168
Observations on a System of Colors 172
Colors, Classes and Orders of, ... 176
" Orders, Species and Varieties, ... 178
" Atomic Theory of, ... 181
Explanation of the Prescriptions or Recipes, ... 182
Primary Class of Colors, (Preface or Remarks on,) 184
Order Yellow, (Remarks on.) Recipes for Yellow, ... 187
Order Red, (Remarks on.) Recipes for Red, ... 193
Order Blue, (Remarks on,) 200
Woaded Blue, (Observations on,) 201
Usual, or Common mode of Setting a Woad-Vat, ... 204
On the Operations connected with Dyeing Wool in the Woad-Vat, and the Plan of Conducting that from day to day, when Coloring in it, ... 208
Ash Blue, (Observations on,) 211
The Method of Setting an Ash-Vat, ... 213
On the Management of an Ash-Vat from day to day, during the time of Coloring in it, ... 214
The Jack-Vat, &c., ... 215
Kettle-Blues—Saxon Blue, ... 217
" " Prussian Blue, (Remarks on,) 218
" " " " (Recipes for,) 220
" " Chrome Blue, " 221
" " Common Logwood Blue, (Recipes for,) 222

Closing Remarks on Order Blue, ... 223

Cost of Dyeing Blue, ... 224-225

Secondary Class of Colors, (Observations on,) 226

Order Aurora, (Observations on,) 227

" " (Recipes for Colors of,) 228

Order Violet, (Observations on,) 231

" " (Recipes for Colors of,) 232

Order Green, (Observations on,) 236

" " (Recipes for Colors of,) 237

Intermedial Class of Colors, (Observations on,) 241

Order Bronze, (Observations on,) 243

" " Minor Shades of Brown, (Recipes for,) 245

" " " " Plum, " 248

" " " " Olive, " 250

Tertiary Class of Colors, (Observations on the,) 252

Order Brown, (Remarks on,) 254

" " (Recipes for Colors of.) 255

Order Plum, (Remarks on,) 259

" " (Recipes for Colors of,) 260

Order Olive, (Remarks on,) 263

" " (Recipes for Colors of,) 263

Aggregate Class of Colors, (Observations on,) 266

Order Black, (Recipes for Colors of,) 268

Mixtures, (Observation on,) 272

Recipes for Mixtures, ... 274

The Science of Colors.—Or the Nature and Properties of Coloring Matter, being an Inquiry into the Ultimate Cause of Color, ... 275

Comparison between the Vegetable Coloring-Principle and the Mineral Coloring Acids, ... 288

A Brief Repetition of the Nature and Properties of the Coloring-Principle, 289

On the Constitution, Affinities, or Properties of Color, ... 292

Indigo, (The Coloring-Principle of,) 299

Cochineal, (The Coloring-Principle of,) 303

THE PROPERTIES AND COMPOSITION
OF THE
DYESTUFFS AND CHYMICAL COMPOUNDS
WHICH ENTER INTO THE
CONSTITUTION OF COLORS.

———o———

TABLE OF CONTENTS.

Astringent Principle, ... 312
Archil, ... 313
Barwood, ... 315
Barks, ... 315
Bran, ... 317
Camwood, ... 318
Cochineal, ... 319
Cudbear, ... 324
Fustic, ... 325
Heath, or Heather, ... 327
Hypernic or Lima Wood, ... 328
Indigo, ... 330
Lac-Dye, ... 336
Logwood, ... 338
Madder, ... 342
Madder Roots, ... 343
Munjeet, ... 344
Nicaragua Wood 346
Nut-Galls, ... 346
Old Madder, ... 348
Peach Wood, ... 348
Quercitron Bark, ... 349
Red Wood, ... 352
Roots, ... 352
Sanders, ... 353

Shumac, ... 353
Sulphate of Indigo, (Chymic) 356
Tannin, ... 359
Valoney, ... 361
Weld or Woald, ... 362
Woad, ... 363
Woad, (Process of Couching) 365
" On Fermentation in general, ... 370
" The different species of Fermentation, ... 375
" The Alkaline species of Fermentation, or the operation of Woad in the Blue Vat, ... 378
Young Fustic, ... 383
On the relation between the Dyestuffs and Chymical Compounds, ... 384
Chymical Compounds, ... 386
The Alkalies, ... 387
Ammonia, ... 388
Soda, ... 389
Potash and Pearlash, ... 390
Lime, ... 392
Urine, ... 393
Potash-Soap, ... 393
The Acids, ... 394
Sulphuric Acid, ... 395
Nitric Acid, ... 396
Muriatic Acid, ... 397
Chymical Salts or Mordants, ... 398
Potash Sulphate of Alumina, ... 398
Super-Tartrate of Potash, ... 400
Solutions of Tin, on the making of, ... 400
Sulphate of Tin, ... 401
Nitrate of Tin—Muriate of Tin—Crystals of Tin, ... 402
Murio-Sulphate of Tin—Murio-Sulphate for Lac, ... 402-3
Nitro-Muriate of Tin, ... 403
Sulphate of Iron, ... 403
Sulphate of Copper—Sulphate of Indigo, ... 405
Prussiate of Potash, ... 405
Argol, ... 406
Prussian Blue, ... 407
Sub-Carbonate of Soda, ... 408
Tin, ... 408
Observations on the Table of Chymical Salts, ... 409
Table of Chymical Compounds or Salts, ... 409

THE

ART OF DYEING

ALL COLORS ON

RAW COTTON OR COTTON WASTE,

FOR THE PURPOSE OF WORKING WITH COLORED WOOL IN THE
MANUFACTURE OF MIXTURES OR PLAIN COLORS ON SATINETTS,
CASHMERETTS, TWEEDS, DOUBLE AND TWIST GOODS,
STOCKENETTE WORK, YARN, AND ALL OTHER WOOLEN
FABRICS INTO WHICH COTTON IS NOW INTRODUCED.

——*ALSO*——

The Methods of Dyeing in all Colors

IN THE PIECE,

ON SUCH CLOTHS AS ARE COMPOSED OF COTTON AND WOOL, OR
WOOLEN WASTE AND COTTON, TOGETHER.

In Two Sections.

INTRODUCTION.

A Treatise on this particular Branch of Dyeing, (so little understood,) has long been wanted; but no time has appeared to call for it so imperatively as the present; when the introduction of more or less Cotton into almost all kinds of Woolen Goods, has become every thing but universal.

The Dyer, in coloring for these low-priced fabrics, has got no small difficulties to contend with; for the nominal price at which these spurious goods are sold, necessarily confines him to the strictest limits of penurious economy, and prevents him from using those processes and materials which are applied at greater expense, but with better success, on articles of a higher value.

Again: he has to contend with the weak affinity with which Cotton retains the color, when subjected to the different processes of the Woolen manufacture; more especially the operations of the Oil necessary in Carding, and the Alkali and Soap, with friction of the Fulling Mill, in the process of Scouring and Fulling.

These are great obstacles, and have hitherto confined manufacturers to a few colors of easy application, owing to the inexperience of most Dyers in any method of surmounting them.

That these difficulties can be overcome, is the subject-matter of the succeeding pages to show; the object in placing them before Dyers and manufacturers being to make known and diffuse generally a series of Operations and a variety of Substances, which, by their Effectiveness, Economy, and Expedition, are better calculated than any other processes I am acquainted with, to supply the wants of these low-priced fabrics, in the article of colors.

Richard Gibson.

SECTION FIRST.

GENERAL OBSERVATIONS ON DYEING RAW COTTON, OR COTTON WASTE.

It is scarcely the province of this work to moralize on the iniquitous practice of mixing Cotton with Wool; and with a view of palming this spurious fabric upon the public as Woolen Goods, yet justice compels us to say that it is a most fraudulent and foolish speculation. Though begun, in the first instance, by an individual or two, for the purpose of self-aggrandizement, and who had no regard either to uprightness of character or the principles of common honesty; such is the nature of humanity, that, very soon, numbers were found to imitate and join them in the nefarious and dastardly business of deceiving and cheating their unsuspecting customers; until, as iniquity is similar to infectious diseases—one or two "scabby sheep have affected the whole flock;" and now, what was begun in dishonesty by a few, is obliged to be continued from necessity by the many.

Although it has, at the present time, become almost an universal practice among Woolen manufacturers to adulterate their fabrics with Cotton, yet the universality of the crime is no excuse for the perpetration of it, or any cover for its villainy; and however it may be winked at on account of its common occurrence, it stands before us in characters of bold relief, as an enormous fraud perpetrated upon those with whom honesty and fair dealing would be the best policy for us to pursue.

But in despite of our moralizing, there is every prospect of this moral disease running on to its final consummation. We will, therefore, proceed to our appointed task as a matter of necessity, and endeavor to explain those processes and principles which bring us Dyers in as co-partners in this grand swindling concern.

In Dyeing the great commercial staple of Cotton, in the raw state, we seem to be performing an operation directly contrary to its nature, for it opposes to this *forced* and *unnatural* process, an *obstinate aversion* to receive or imbibe the liquid color, or the mordant intended for combination with it; and when, by *dint* of excessive boiling, it has been *forced* to absorb a certain quantity of liquor, it retains it (by the contraction of its fibres,) with such tenacity, that no common draining or pressure will clear it from the liquor of a *first operation* sufficiently to enable it to receive the full *benefit* of a *second.* To this may be added the very feeble affinity of Cotton for coloring matters; which seem, in most cases, only to combine with it through the intervention of a third substance, which acts as an agent or medium of connection between the two.

These, then, are the principal opposing difficulties in the dyeing of Raw Cotton, which the Dyer will always bear in mind when attempting to color this refractory vegetable substance.

Furthermore, when the Cotton *has* been dyed, and that *only by main force*, it requires such a length of time to dry it, and is so expensive and dangerous by fire, in winter, that we are constrained to acknowledge our folly in attempting to perform that which Nature so plainly shows to be in direct opposition to her laws. I think, sometimes, if this poor, tortured article of a nefarious manufacture could but speak, it would talk to the Dyer and the Manufacturer in this manner:—"You fools! do you think you can convert me into Wool by coloring? Don't you know I have no *natural affinity* for color? You know you cannot *wet* me without violence in boiling, and then you cannot *dry* me without roasting; so let me alone! go away! use Wool and act like sensible and honest men!" But we must waive this digression, and proceed with our subject.

Having seen by the preceding remarks, that the causes operating against the easy and straightforward application of colors to Cotton (as compared with Wool,) are three, viz:

1st. Its *weak* affinity or *feeble* attraction for colors.

2d. Its obstinacy in retaining water when once imbibed.

3d. Its *small power* to *retain* colors when exposed to the action of external agents.

We have, therefore, to examine these carefully in order to come at the best plans and materials for producing the most desirable results.

1st. The first point to be considered in dyeing Cotton, whether in the state of raw material, in yarn, or in the manufactured fabric, is the *difficulty*, or shyness with which it assumes color; but experience has taught us that it combines with some colors or coloring matters, easier and more permanently than with others, and these are such substances as contain most astringency in their watery solutions.

From this it appears that Cotton has a stronger attraction or affinity for *Tannin*, or the Astringent principle, than for any other substance used in the processes of Dyeing. Hence the propriety of impregnating the Cotton with the astringent or Tannin principle previous to Dyeing, becomes apparent; especially for dark colors, and all such shades as will bear this foundation.

Yet this preliminary preparation of the Cotton cannot be considered so much a *Dyeing* operation as a *preparatory step* to the succeeding processes more properly termed Dyeing; for the astringent principle is *not* a Dye or Color, but only the *means* or *agent* whereby a *union* is more *readily effected* between the article to be colored and the coloring matter.

Many vegetable substances afford this indispensable article for Cotton Dyeing; among them are roots, barks, shrubs, and the ligneous bodies of some trees, nut-galls, and a variety of other vegetable matters. Shumac and nut-galls, and also Divi-divi are chiefly used for yarn and cloth; while catechu and cutch with (occasionally,) shumac, are the mediæ for raw Cotton Dyeing. The use of this Astringent principle in the process of tanning leather is known to every one, from which, when pure and freed from all other matters, it has derived its chemical name of *Tannin*. The processes of tanning hide, and the shumacking of Cotton are so similar in object, that the latter might not inaptly be termed the *Tannin Process*, to distinguish it from those operations which produce Colors proper.

Those substances that are best for the Tannery are best for the Dye-house in this process; *price* and *quality* of materials always taken into consideration.

2d. When Cotton has been subjected to any process of Dyeing, whether to shumac, mordant, or partially to color it, we have seen that it is very difficult to drain; and this liquor of the *first* operation, being carried into that of a different kind in a *second* operation, either partially destroys the latter, or prevents it from having its full effect.

In order to obviate this difficulty, *we must*, in *all cases*, and for *all Colors* requiring two or more distinct liquors, free the Cotton as much as possible from the remains of the preceding dip. In some instances, simple but thorough draining will suffice; in others, it will be necessary, even, to wash off and drain well.

This purgation of the Cotton between the several dips, being of the utmost consequence, to produce GOOD colors, economically, these instructions will be repeated when giving the recipes, and treating of the several Colors separately.

As Cotton absorbs Color the best when freest from moisture, and will scarcely color at all when saturated with liquid (whether it be water only, or coloring liquor,) it follows, as a matter of course, that we cannot deprive it too much of its super-abundant liquor, before submitting it to a fresh Dyeing process. As the common mode of draining requires too much time, and never *fairly* effects the object, the most certain method is to expose the wet Cotton to the rapid motion of a Patent Extractor (so-called,) which never fails to leave it in a proper state for the next operation.

These machines are now in use at SOME establishments, and ought to be in EVERY ONE where raw Cotton is colored; they are not of much consequence in Wool-coloring, but for raw Cotton coloring, they may be said to be *indispensable*, where economy and good colors are the objects to be attained.

3d. We have now to ascertain the reason why the *same* coloring-matter or rather colors, placed on Cotton, cannot resist the action of those external agencies which remove them, as well as the same colors do when applied on Wool.

This is easily answered and understood; for the actual result of the Dyeing is *different* on the two materials: the one being only a *mechanical fixation* of the color on the *fibres* of the Cotton; whilst the other is a *Chymical combination* of it with the *body* of the Wool.

This difference accounts at once for the discrepancies observed when the two are exposed alike to the same tests (whether those tests be Chymical or Mechanical,) for in the operations of manufacturing them together into one fabric, the colors on the Cotton always suffer a greater deterioration than those on Wool: and also in the subsequent *wear* and exposure to the atmosphere and weather the Cotton colors disappear the first in almost all cases.

Submitted to any kind of tests, these remarks will be found to hold good; the *modes* in which the Color arranges itself with the two substances being sufficient to account for the consequences we observe: for the one is merely *attached to*, whilst the other is *combined with* the coloring matter.

The inferiority in point of endurance is the grand object of the Dyer to overcome, and can only be done, in the first place, by bringing the Cotton into a state for receiving and retaining Color (a quality it does not naturally possess,) by exposing it to the *Tannin* process. 2. Then in a fresh liquor, submitting it to the *mordant* process, which is a solution of metallic or earthy salts. And finally subjecting it to the Dyeing process in another liquor, composed of such coloring matters as *that* particular color requires; taking care through all these processes to keep them isolated, so that no portion of one liquor shall be carried into the succeeding one, and this is to be consummated by draining, washing, and extracting between the consecutive operations.

THE DYE-HOUSE.

The situation and construction of a Dye-house is of far more importance than most persons imagine, both in respect to economy and the production of good colors. Ninety-nine out of a hundred of these *hog-styes* going by the name of Dye-houses, are no more calculated for the purposes of coloring than they are for jeweler's shops; and in winter, especially, are not fit for either man or beast to be exposed in.

It is not one of these *dens* that I am going to portray before you, but a place that shall be adapted to answer the purpose for which it is intended. As each particular branch of Dyeing requires a different internal arrangement and apparatus in the Dye-house; I am only going to describe one that is expressly intended for the Dyeing of raw Cotton and the Wool that is to be manufactured with it, into a mixed fabric.

Having ascertained that you have got *head* and *fall* enough of water, then let the site of the Dye-house buildings be as near the factory as convenient, but detached from it: let the Dry-house, Dye-house and Drug-room form one continuous building of brick or stone, (in *size*, according to the quantity of work expected to be performed in it.) At one end of it have the Dry-house, and at the other, the Drug-room; both these divided from the Dye-house proper, by partition-walls running up to the roof, with door-ways into the Dye-house, and have the internal *form* of each room, a parallelogram, and *not* a square.

Let the whole building be two stories high to the square of the roof; the Dye-house part, open to the roof, with ventilators through it over each kettle or box; the other two parts divided, each into two stories by an intermediate floor, the Dry-house part having a slatted or open floor; the Drug-room a close one.

Let the whole building extend lengthways, east and west, if possible, so that a platform for Drying the Cotton and Wool in favorable weather, running the whole length of the building and sloping towards the south from a level with the Dye-house floor, may receive all the benefits of the sun's rays.

Let a door open from the Dye-house upon the platform, and other doors out of the separate rooms in other directions, to suit convenience; give plenty of light, especially into the Dye-house, by having a sufficiency of good-sized windows: provide for a good circulation of air in summer; and for warmth in winter, by a good stove in the Dye-house.

Under the floor of the Dye-house, have one main sewer lower than the bottoms of the kettles, into which conduct branches from each kettle, for running off the exhausted Dyes. Let the ground floors of these three rooms be all on one level, only in the case of the Dye-house, instead of being equally flat throughout, it must incline gently from each side to the middle, where a small open sewer running the whole length, will conduct the water from the floor, into the main sewer underneath.

The kettles will be all of one capacity, and each capable of Dyeing one hundred or two hundred pounds of Cotton, or three hundred pounds of Wool; and will be three in number, arranged in one parallel on the longest side of the building; to stand three feet high from the floor (the supply-water being above that height,) at equal distances from each other, and from the end walls, say three feet between their extreme circumferences.

On the opposite side of the Dye-house, the scour-kettle and wash-box will be placed; and the intermediate space will be occupied by the scrays, and other moveable apparatus, employed in the Dye-house for various purposes. It will be seen by this description, that the inside space of the Dye-house will be thirty-two by twenty-four feet, or seven hundred and sixty-eight square feet.

Each kettle must be provided with a *false* bottom, pierced with holes, or made of open-work, to rest about four or six inches above the real bottom: this is for the purpose of draining the Cotton or Wool more effectually, when the kettle is drawn off. No Dyeing vessel can be considered complete without this attachment.

Light wood covers are also useful, and sometimes necessary. Attached to the kettle by its lower end resting on, and immediately over the inner edge of the kettle, is a sort of wide platform inclining towards the kettle, from an elevation above and beyond it: this fixture is for throwing the Cotton upon, when it is necessary to preserve the liquor in which it has been Dyed.

This draft is based on a calculation for three setts of machinery, or on the supposition of three hundred pounds of Cotton and

Wool being required daily; although it will do considerable more in cases of necessity: yet, in devising a Dye-house for only one sett of machines, it will be well to follow precisely the same plan, only, in all particulars, going on a smaller scale.

To some who have not studied the nature of this kind of Dyeing in all its bearings, the idea of using three kettles may appear absurd. But those who *know* that raw Cotton requires two and even three different and dissimilar liquors to dye most of the colors, and that these liquors must be at a great strength, and furthermore, the longer they are kept (in many cases) the better they will color, will at once see not only the propriety but the absolute *necessity* of having a separate vessel for each liquor, in order to take advantage of every circumstance tending to improve the colors, or economise the expensive materials that produce them. I, therefore, call this arrangement of three kettles, a *suit;* for they certainly are more suitable to produce better colors at a vast deal less expense in the long run, than either *one* or even two do, as I will show by one example, and let that suffice.

Take the best black, for instance: this requires three operations, viz.: the Tannin, Mordant and Dyeing processes; all separate—now, with one kettle you have to throw away, each time you color a kettle-full, every one of your half-used liquors; whereas, in the case of the three kettles you *preserve all* the liquors, and the next Dyeing you have only to use two-thirds the quantity of drugs, as in the first, and obtain a better color: so at three successive Dyeings, the *three kettle plan* has the advantage over the one kettle, in point of cost, of one-third the whole amount, and so in all other matters connected with the economical use of Dyestuffs.

We cannot dismiss this subject without drawing a comparison between the two methods of heating a Dye-house: one by a steam boiler, and the other by firing up the kettles separately.

The idea most prevalent at present seems to be, that one very large kettle is better than two or more of medium size; this notion prevails most among the small establishments, under the impression that it economizes labor and fuel, than which nothing can be more erroneous and absurd. Besides the loss sustained in Dyestuffs—as before shown—it can be clearly proved that the *first-cost* or original outlay of capital is *greater* than would fit up such a Dye-house as we have described, when heated by steam; independent of the loss afterwards sustained by applying the fire directly to the kettle.

There are of these large copper kettles at some of the small factories, that will cost, at present rates, eight hundred dollars; and I have seen some that have cost over a thousand. On this basis we will go to work with figures—those correct demonstrators of facts:—

FIRST COST, BY HEATING WITH FIRE DIRECT.

Copper Kettle,	$1,000
Brick Work,	30
Fire-place and Grates,	15
Labor of Setting, &c.,	15
Total,	$1,060

FIRST COST, BY STEAM-HEATING.

Boiler, ready for action,	$375
Three Dye-tubs, $30 each, wood,	90
Scour-tub and Wash-box, do.	30
Fitting up Steam-pipes, &c.,	110
Total,	$605
Difference in favor of Steam,	$455

Thus it appears, by this statement, that a steam-heated Dye-house can be fitted up with two-fifths the less expense, than when fire is directly applied to one or more kettles.

Concerning the regular or daily consumption of fuel on the two plans, there needs but few words on the subject, as it is a well-known fact to every one whom experience and observation has made acquainted with the effects of steam, that a body of water can be heated by it at two-thirds less expense than by fire direct. The reason of this difference could be explained on philosophical principles, if there was any particular necessity for it.

The surplus steam can be used for a variety of purposes around the establishment, where heat is required.

The conclusion to which any one will naturally come from examining the above statement, will be, that when there are two or more setts of machinery, heating by steam is decidedly the cheapest and best mode, on many accounts.

We have only to substitute the words wooden tub in place of kettle, in reading this description, when we have the proper arrangement of a Steam Dye-house.

We have said about all that is necessary on the construction and arrangement of a Dye-house for this particular kind of Dyeing; and have only to remark that it makes a strange contrast with the majority of the hovels disgracing that name.

Nevertheless, this or similar plans, are not what they are, but what all Dye-houses *ought to be* constructed on; therefore, this description of a Dye-house is recommended to the attention and study of any one about to erect a new, or alter an old one.

Some, no doubt, will think it worth while to follow its leading features, whilst others, "wiser than that which is written," may disregard it altogether. The best thing we can do in their case is, to leave them in the quiet possession of their errors.

PARTICULAR DIRECTIONS FOR DYEING.

Supposing, now, that we have got a Dye-house of the best construction and arrangement for performing the business in the most satisfactory manner, we have next to describe the making of the Dyeing liquors, and the treatment of the Cotton in the act of Coloring.

These things, being of the first importance, cannot be too forcibly pressed on the attention of the Dyer, as on him mainly depends the good success of the Dyeing.

The most important consideration, in preparing the Dyeing liquors, is to have them *clear*, and perfectly free from sediments or loose Dyestuffs, when ready to receive the Cotton or Wool:—the best means of insuring this result, is to employ either the *solid* or *liquid* extracts of the Dyestuffs; but as these cannot always be come at, and drugs in the rough state have to be used instead, the method of managing these, with the view of producing similar results, is to mix the chipped and ground articles together, before bagging them, and not to throw any of the ground stuffs loose into the kettle, notwithstanding a common practice to the contrary.

Let the fabric of the bags be open enough to allow of the color passing freely, without letting any of the *ground* stuffs work through it into the liquor.

In filling the bags, leave room enough for the Dyestuffs to move about in, whilst boiling.

Some drugs give out their color quicker than others; but some require more than two hours boiling, if properly managed.

In using extracts solely, the liquor is ready for use as soon as they are dissolved.

When Chymical salts, otherwise Mordants, have to be used in the Dyeing liquor, (such as sulphate of iron, &c.), note that these are not put in before the bags containing the rough Dyestuffs are withdrawn from the kettle; but if an alkali is to be used, put that in during the boiling of the bags, as it facilitates the extraction of the color.

TREATMENT OF THE COTTON IN THE DYEING OPERATIONS.

Having withdrawn the bags from the kettle, all is now ready for commencing operations. Shake down and open the Cotton well, in front of the kettle, then heave it in as expeditiously as possible, (the liquor boiling at the same time,) then break up well with the levers, and get the whole thoroughly wet as soon as may be: boil an hour, in order to be sure that the whole is completely impregnated with the liquor. Here observe, that Cotton requires no more boiling in the processes of Dyeing, than what is sufficient to imbue all parts of it evenly and completely with the Dye; the fact is, that it combines with the *Tannin*, Mordant or coloring matter better at a temperature far below a boil heat, than by boiling; and it is only because it will not wet without it in the first instance, that any great amount of boiling is necessary; but there is one circumstance connected with raw Cotton Dyeing, which must not be overlooked or slighted; that is, it requires time or age in the operations: it is of far more importance to give time in the liquors than it is to boil it in them. The truth is, it must have a great length of time for exposure to the liquors, as it takes up the coloring matters only slowly under any circumstances, but always under a boil, better than with it: it is, therefore proper, nay necessary, that the Cotton be left in the liquor all night, yet when this is not practicable, then let it remain immersed not less than six hours. Before proceeding to any second operation, I again repeat, make sure that the Cotton is as free from the preceding liquor as possible, and all the flakes well shook out before again immersing it in another bath or liquor. Let this be the case always, and for all colors.

There is another point in Dyeing, which it is imperative on us to observe, viz.: the quantity of Cotton to expose in a kettle at one time. Attention is particularly called to this question, from the fact that it is a universal practice to cram or stuff as much into the kettle as can possibly be forced into it, and the consequence is that it is not *Dyed at all*—merely *stained*—with more shades of color than there was in the Iris-colored coat of the beloved son of Jacob, but devoid alike both of beauty and durability.

This practice of overcharging the kettles, cannot be too much reprobated, as it turns out in its results a mere mockery of Dyeing. Therefore, in all colors, but more especially for light ones and such as strike quickly, give plenty of room in the kettle; let the boil be able to rush through and through it, or the liquor float every fibre of it.

It is a very bad practice to CROWD Wool in the kettle, but it is much more so to crowd or cram Cotton.

You will, therefore, proportion the quantity of Cotton to the size of the Dyeing vessel, reckoning, whatever may be the capacity of the latter, that one-half for light and two-thirds the quantity for dark colors of the Wool that a kettle will Dye comfortably, is the proper quantity of Cotton to color in the same vessel: taking a kettle that is roomy enough for three hundred pounds of Wool, then two hundred pounds, for dark colors, and one hundred and fifty pounds, for light ones, of Cotton, is the proper charge: this proportion not to be exceeded, all opinions to the contrary, notwithstanding. By following these directions, economical, good and permanent colors can be obtained, but by persevering in an opposite, and, at present senseless course, we can expect no less than a waste of Dyestuffs, without producing any desirable results.

THE RECIPES.

System and Simplicity in the operations and materials of Dyeing, are absolutely essential for conducting the business with ease and certainty. Where there is neither a regular plan with the processes, nor a certitude in proportioning the quantity or kinds of the materials, we may be sure that it can be no other than a chance enterprize, at all times uncertain in its results.

Certainty, System and Simplicity are the grand desiderata connected with Dyeing; and with these in view, the following recipes are arranged on a regular scale, descending from the lightest to the darkest shades; and for producing them, the smallest number and the most efficient materials have been selected.

These formula are the condensed results of much experience, and have been chosen as the best specimens out of many others, which of themselves produce good colors.

Having long practised with them, and given the preference to them before all other recipes, on account of their simplicity, certainty and effectiveness, they can be fully depended upon for the accuracy of their results. The standard or calculation of the drugs employed is based, in each case, on one hundred pounds of raw Cotton; therefore, in Dyeing any larger quantity at once, the weight of all the Dyestuffs will have to be increased in the same ratio.

There will be observations attached to such of them as require any departure from the general mode of Dyeing; and in several instances examples will be given of producing the same color by different methods and materials.

For the plan of working these recipes, you will consult the preceding pages, under the heads of "General Observations on Dyeing Raw Cotton or Cotton Waste," page 9, and "Particular Directions for Dyeing," page 18.

In publishing these valuable memoranda, some persons who have labored a little in Dye-houses, and who *think* they are Dyers, because they can distinguish one kind of Dyestuff from another, and can handle the apparatus used in coloring; may, through their ignorance and shortsightedness take umbrage, and stigmatize the author as a mean, unprincipled scoundrel, for thus exposing the secrets of their craft.

We want a few words with these fellows, for we have heard their remarks. We want to tell them that they have "neither part nor lot in this matter," for we know very well that ignorance is ever tenacious of the little that it knows, and makes a secret and a mystery of the most trivial circumstances. God help you, poor devils, you may well be irritated and afraid of *your* knowledge being made too public, for it's very little that you know; therefore, be sure and hold fast to it, or you will lose it altogether.

But don't be alarmed without a cause: none of *your* knowledge will be placed before the public in this little volume. All that it contains is the *sole property* of its author—the fruit of his own ideas, his own experience and untiring perseverance; and he, poor, simple fool, thinks he has a *right* "to do what he will with his *own*."

However, he will presume to exercise such a right; and in giving nothing to the world but what is the result of his own experience and discoveries, he willingly assumes the responsibility of standing or falling in the estimation of those men, whose knowledge of the constitution and combinations of the Dyestuffs, their masterly and talented method of managing them, may be termed the only real Dyers; and these, thinking with the author that the more light is thrown upon the business, the more will its best interests be served, are the true and only judges of the propriety of the act; to whose decision this little volume and the reputation of its author are most cheerfully submitted.

THE RECIPES.

Systematic Arrangement of the Colors—According to their Natural Order.

Prismatic Division.

SIMPLE COLORS.

Yellow, Red, Blue.

—o—

COMPOUND COLORS.

Aurora, Green, Purple.

—o—

Non-Prismatic Division.

TRIPLE COLORS.

Brown, Olive, Black.

—o—

MINOR COLORS.

Fawns, Drabs, Slates.

THIS table comprises every color, and every distinctive variety of artificial color, artistically applied in Dyeing or Printing: no matter whatever the fabric may be with which they are combined; this classification stands good in all cases; for it is an Elementary system, the foundation of the science of colors, and the regulator of their application in the art of Dyeing.

It is *the* system of colors; as perfect in all its parts as the law of Nature which governs it is perfect and immutable.

The systems of Botany, Geology, Ornithology, &c., are not more clear, simple or decisive than this.

Its various connections and combinations can be exhibited with all the certainty of mathematical deductions.

This "system of colors" is fully illustrated in my treatise on the "System and Science of Colors," in this volume, wherein the author does not claim it as *his* system, although he has been the *first* to point it out as *a system* existing in Nature for all eternity.

BLACK.

THIS color is the most common of any on raw Cotton, and many and diverse are the ways in which it may be colored. A few of these will be illustrated as follows:

EXAMPLE FIRST.

First Process and First Kettle-full.

Shumac, 25 lbs.
Catechu, 15 "
Logwood, 25 " (Chips.)

Mix, bag, boil and withdraw, as described in "Particular directions for Dyeing;" which see. Then add

Sulphate of Copper, 5 lbs.

Now enter the Cotton as before enjoined, which you must always bear in mind.

Boil one hour, and let it remain in all night. Next morning take out the Cotton and add to the liquor

Logwood, 55 lbs.
Soda Ash, 7½ "

Boil an hour, withdraw the bags, and stay the boil; then give

Sulphate of Copper, 5 lbs.

When this is dissolved, and the foaming of the liquor has ceased, enter the Cotton; handle well, and simmer a little.

Let it remain in all night, and in the morning heave it out, and save the liquor for another Dyeing.

This is on starting a new liquor.

SECOND DYEING IN THE SAME LIQUOR.

Shumac, 16 lbs.
Catechu 10 "
Logwood, 15 " (Chipped.)

MIX, bag, boil an hour, withdraw the bags, and then add

Sulphate of Copper, 2½ lbs.

Enter the Cotton, as before, boil an hour, and let it remain two or three hours in the liquor (or six if convenient;) then heave out and give the liquor

Logwood Chips, 50 lbs.
Soda Ash, - 5 "

Boil an hour, then withdraw the bags, give

Sulphate of Copper, 5 lbs.

Re-enter the Cotton, as before, in first Dyeing; let it stay in all night; take out the Cotton in the morning, and save the liquor of the kettle for further use.

This mode of coloring is calculated to go on *ad infinitum:* Dyeing in the same liquor continually, provided it is kept free from the loose Dyestuffs.

A variation may be made in this recipe, by substituting ten pounds of Fustic in place of fifteen pounds of Shumac, and its effects will be about the same.

Proceed in the subsequent Dyeings as prescribed for the second Dyeing; and although the first and second Dyeings will not be so good as the succeeding ones, the liquor will improve by *age* and use, and give colors to your satisfaction.

ANOTHER METHOD.

First Dyeing and First Process.

To a vessel of clean water, add the following drugs:

Shumac, 25 lbs.
Catechu, 15 " (or Cutch.)
Logwood, 60 " (Chipped.)

Proceed by mixing the Shumac and Logwood chips together before bagging them, then boil them an hour or an hour and a half; withdraw the bags and add

Sulphate of Copper, 5 lbs.

Enter the Cotton, and boil till it is thoroughly saturated with the liquor: stay the boil and let it remain in the kettle all night.

In the morning take out and let the Cotton drain as long as possible, in order to *air* or *age*.

Save the liquor of the kettles for further use.

Then to another vat of fresh cold water, give

Sulphate of Copper, 1½ lbs.
Sulphate of Iron, 3 lbs.
Pyrolignate of Iron, 6 or 8 pints.

Enter the drained Cotton into this as expeditiously as possible; *handle*, or break it up well, and let it remain in this two or three hours, or even all night, if found convenient; after taking it out of this solution, allow it to remain draining as long as time will admit of before washing it, as the color gains both in solidity and permanence, by lying some time in the iron. If pinched for time, you may heat up the iron liquor kettle to near a boil; then enter the Cotton, and let it remain about an hour, and take it out. This is, occasionally, a little more expeditious than employing it cold, and some Dyers may prefer it. Empty the kettle with the Cotton in it; then after it has drained thoroughly, run it up again once or twice with water to wash off.

Empty the iron liquor vessel every time, or certainly not finish in it more than two or three times, but it is the safest to have a fresh liquor each Dyeing.

SECOND DYEING IN THE SAME LIQUOR.

First Process.

To the first liquor of the preceding Dyeing, add

Shumac, 20 lbs.
Catechu, 10 " (or Cutch.)
Logwood, 60 lbs. (Chipped.)

Treat these Dyestuffs as before, and then add

Sulphate of Copper, 4 lbs.

Boil the Cotton an hour, and let it remain in the liquor six hours *at least:* all night if convenient.

In the morning finish off in the iron liquor, exactly as prescribed for the first Dyeing.

After the first Dyeing (in this method,) the succeeding ones may be Dyed off in one day, by entering into the iron liquor in the latter part of the afternoon, and letting the Cotton remain in the cold liquor over night: but a little experience and common forethought will indicate the best and most expeditious mode of procedure.

N. B. It is optional whether you use any Soda Ash in the first liquor, or not.

This method of Dyeing resists the Fulling mill better than the first example.

THIRD EXAMPLE.

Tannin Process.

Fustic, 10 lbs.
Catechu, 10 lbs. (or Cutch.).
Sulphate of Copper, 2½ lbs.

Dissolve all together; enter the Cotton, and boil as usual; let it remain in all night: in the morning take out and drain effectually by the *Extractor*. Save the Tannin liquor.

Mordant Process.

Bichromate of Potash, 5 lbs.
Sulphate of Copper, 5 lbs.

Enter at a boil-heat, and let it remain in two hours: take out and drain well; then wash off thoroughly, use the Extractor. Shake the Cotton loose in front of the kettle, and then proced to the

Dyeing Process.

Logwood, 75 lbs. } Chips.
Fustic, 5 " } Chips.

Treat the Dyestuffs as in the preceding examples; then add

Sulphate of Copper, 1½ lbs.

Enter expeditiously at a boil-heat, handle well without boiling. Let it remain until deep enough in shade.

This is the softest, most velvety, fastest and most beautiful black that can be Dyed on Cotton.

OLIVE.

THIS color appears to be a composition of Black, Brown and Green, combined in different proportions, as its shades happen to incline towards either the Brown or the Green: it occupies the intermediate space between Black and Brown, in this arrangement of the colors. It comports itself into three distinct varieties or shades, namely: Olive proper, or the real Olive; Brown Olive, and Green Olive, known as such in Wool Dyeing.

The latter may be considered in Dyeing as a composition of Black, Brown and Green; the Green prevailing: the true, or real, or pure Olive, (which is the standard shade,) is an equal union of the Black, Brown and Green: the Brown Olive is composed of the same colors, with the Brown in excess.

In Dyeing these different shades or varieties, you incline them from the pure Olive towards the Brown, by using more Cutch (or some red-giving substance;) and towards the Green, by using less Fustic (or some yellow-giving substance,) and less Cutch.

This color ranks next to Black, in depth or intensity of hue: it is a very heavy color, and requires much Dyestuff to produce it upon Cotton.

There are different methods of Dyeing it, of which examples will be given.

FIRST DYEING.

Catechu, 25 lbs. (or rather Cutch.)
Fustic, 50 lbs. (Chips.)
Logwood, 25 lbs. (Chips.)

TREAT the Dyestuffs in the manner described for Black; then add of

Sulphate of Copper, 5 lbs.

Enter the Cotton and boil, &c., as usual; let it remain in the kettle all night, if possible: then take out and allow it to drain and air thoroughly: in the meantime strengthen the liquor by boiling out the following drugs:

Fustic chips, 10 lbs.
Logwood chips, 5 lbs.
Cutch, or Catechu, 5 lbs.

Withdraw the bags, and dissolve in the liquor, separately:

Sulphate of Copper, 2½ lbs.
Soda Ash, 5 lbs.

Having opened and aired the Cotton well, and allowed the foaming of the liquor to cease, enter the Cotton quickly, at a boil: handle smartly, and in half an hour check the boil, and let it remain in the kettle as long as time permits.

Save the liquor for further use in subsequent Dyeings.

SECOND DYEING IN THE SAME LIQUOR.

Cutch,	20 lbs.
Fustic,	40 "
Logwood;	20 "

Treat these as in all previous cases have been described, then add

Sulphate of Copper, 5 lbs.

Enter the Cotton, handle and boil, till thoroughly saturated with the Dye: let it remain in the liquor six hours at least, or as much longer as circumstances will permit: then heave out and give plenty of time for thorough drainage and airing; and in the interim boil up for an hour or an hour and a half.

Fustic chips,	10 lbs.
Logwood,	5 "
Cutch,	5 "

After these are boiled out and the bags withdrawn, dissolve separately—

Sulphate of Copper,	2½ lbs.
Soda Ash,	5 "

Then introduce the Cotton as before, at a boil, with smart handling, for half an hour: let it remain here a sufficient time, when it is finished.

In subsequent Dyeings proceed *secundum artem.*

By preserving this liquor, you can color without shifting the kettle for a long time; taking care always to keep it free from sediments and loose Dyestuffs.

It is to be observed here that in Dyeing both Black and this color, that an indiscriminate use has been assigned to Cutch and Catechu; the reason is, that at the present time, and for a long while back, there has been such an adulteration of Cutch, on account of its scarcity, that in many instances the Catechu has contained more Tannin, or the Astringent principle in it, than there was in the Cutch, consequently making it the better and cheaper article.

ANOTHER METHOD.

Tannin Process.

Cutch, 25 lbs.
Shumac, 15 lbs.
Sulphate of Copper, 5 lbs.

THE Shumac should be separately boiled, and its clear liquor (devoid of sediment) added to the Cutch liquor and Sulphate of Copper. Enter at a boil, and keep it so for a sufficient time to wet the whole, and let it soak in the liquor as long as possible. Take out the Cotton, and preserve the liquor for other Dyeings.

Deprive it of its liquor left by the draining, by putting into the Extractor: shake down in front of the kettle.

Mordant Process.

Bichromate of Potash, 5 lbs.
Bisulphate of Copper, 2½ lbs.

Enter the Cotton into this solution at a boil-heat, and handle well for a short time; let it remain two hours at least: take out; wash off, and then use the Extractor. If you have vessels enough you may save this liquor; only drawing off a little of the bottom to carry out the sediment before using it a second time.

Dyeing Process.

Logwood chips, 25 lbs.
Fustic chips, 50 lbs.

Boil these two hours; withdraw the bags, and add

Sulphate of Copper, 2½ lbs.

Enter the Cotton (well shook over) at a boil heat, as quick as possible; handle well, and let it remain as long as possible.

This is decidedly the best, although the most tedious and expensive of the two operations. But its permanence can at all times be relied upon, and the ease with which it is afterwards worked in the process of manufacturing, sufficiently compensates for the little extra trouble and expense in its production.

BROWN.

This color, when properly Dyed, is the most permanent and intense of any that can be produced on raw Cotton. When Dyed by the best methods, it keeps continually growing deeper and richer by age, and after having been Dyed a month, will be found to have improved greatly; exposure to the atmosphere, and the processes of manufacturing, always producing beneficial effects upon it: for these reasons, it is one of the most desirable colors for Cotton and Wool goods.

The above good qualities are due to the materials with which it is Dyed; and all colors, into whose composition any of these materials enter, partake more or less of these desirable features which distinguish the Brown.

For instance, the Chrome Black, the Olive and other colors, Dyed with a portion of Cutch and Bichromate of Potash, (or with either of them, independent of the other,) are more permanent than if Dyed without their aid: for both of these materials have a great affinity for Cotton, and the colors produced by their assistance are remarkable for their durability and beauty.

We should, therefore, employ these materials in all cases where the nature of the colors will admit of their application. There is quite a variety of the shades of Browns, but they are mainly covered by two or three separate and distinct peculiarities: the Dark Brown, Red Brown and Yellow Brown, generally known as Snuff Brown: these can all be produced chiefly by a variation in the relative quantities of the different materials for Dyeing Brown.

EXAMPLE FIRST.

First Process and First Kettle-Full.

Cutch, 25 lbs.
Logwood chips, 25 lbs.
Fustic chips, 25 lbs.

BAG all these and boil two hours, then withdraw the bags, and add Sulphate of Copper, 5 lbs.

Enter the Cotton at a boil, and continue it until the whole is saturated with the liquor: let it stay in the kettle all night.

Second Operation.

In the morning take out and let the Cotton drain well, and then shake over, whilst in the meantime you strengthen the liquor by boiling up Cutch, 25 lbs.
Sulphate of Copper, 5 lbs.

Re-enter the Cotton, and boil gently for half an hour; then let it remain as long as convenient.

You may omit the Fustic in this recipe if you think proper; but it gives considerable more body and tone to the color; however, the use or omission of this article is optional, as it does not affect the general character of the color.

You may also use or not, for the purpose of varying the shade, Soda Ash, two or three pounds, in the last operation of Dyeing: or you may substitute Hematine for Logwood chips, in the proportion of one pound of the first, for four or five of the latter article.

Save this liquor for continual use, as the older it is, the more used, the better it colors.

SECOND DYEING.

First Process.

To the liquor of the former Dyeing, add
Cutch, 25 lbs.
Logwood chips, 25 lbs.

After boiling these for an hour, then add
Sulphate of Copper, 3 lbs.

Enter the Cotton and boil until thoroughly wet with the liquid, and let it remain as long as possible: take out and drain as long as time will allow: in the mean time boiling up
Cutch, 25 lbs.
Sulphate of Copper, 4 lbs.

Re-enter the Cotton and proceed to handle it and simmer for a short time; then let it remain all night in the kettle.

By this method a kettle-full each day may be comfortably got off: always entering the last time, late in the afternoon, and giving it a chance of taking up all the color, by keeping it in the liquor all night.

For all the dark, heavy, saturated colors, you cannot be too particular in giving them plenty of time in the liquors, so that they may have a fair chance to imbibe as much color as they can combine with. Give them also as much time between the operations as possible, so that they may drain and air well. You cannot be too particular on these points, as the beauty, depth and durability of the color depends in a great measure on these circumstances.

ANOTHER METHOD.

CHROME BROWN.

Tannin Process—First Process and First Dyeing.

Quercitrine, 5 lbs.
Hematine, 5 lbs.
Cutch, 25 lbs.
Sulphate of Copper, 5 lbs.

DISSOLVE all these ingredients together, and then enter the Cotton at a boil, continue boiling for an hour, or until the whole is thoroughly impregnated with the liquid: let it remain in the liquor two hours; take out, and allow it to drain and air as long as time will admit; in the interval, dissolve in the same liquor

Cutch, 25 lbs.
Quercitrine, 2½ lbs.
Hematine, 2½ lbs.
Sulphate of Copper, 2½ lbs.

Re-enter the Cotton into the kettle, boil an hour and leave in the Cotton all night.

Mordant Process.

Take out the Cotton, and save the Cutch-liquor for other Dyeings: drain the Cotton and extract all the Cutch-liquor from it; then make a fresh bath with

Bisulphate of Copper, 2½ lbs.
Bichromate of Potash, 5 lbs.

Enter at boil-heat, and let it remain two and a half hours: heave out and air well before washing off. If the Cutch is not of the very best quality, use ten pounds more than specified above in the first operation, and five more in the last operation of the Tannin Process.

SECOND DYEING IN THE SAME LIQUOR.

Tannin Process.

Cutch, 50 lbs.
Hemantine, 5 lbs.
Quercitrine, 5 lbs.
Bisulphate of Copper, 5 lbs.

DISSOLVE all together; enter the Cotton at a boil, which continue for two hours: then lay it down in the liquor for the night: in the morning take out; drain well and extract: shake over the Cotton and then finish in the

Mordant Process.

Bichromate of Potash, 5 lbs.
Bisulphate of Copper, 2½ lbs.

Enter briskly at a boil heat, and handle well; let it remain in this two and a half hours, then take out and save your Chrome-liquor (if you think proper): after airing awhile wash the Cotton for drying.

You may vary the shade of this Brown, by omitting the Bisulphate of Copper in the Mordant process; although it gives a more solid and intense color when used: the redder the shade is wanted, the less Sulphate of Copper and the more Bichromate of Potash must be used. If the shade is required to be light and yellow, or a cinnamon color, use more Cutch and Quercitrine, or a body of Fustic and no Hematine or Logwood, and finish off with Bichromate of Potash alone.

If the shade be wanted deep and full, give more Hematine and Cutch, and finish with both the Bichromate of Potash and Bisulphate of Copper. The quantity of Cutch allowed above, is only for a medium Brown.

Your own judgment ought to dictate to you the best methods of hitting any particular shade or pattern, after studying this standard.

Another shade may be obtained by the following method.

To the liquor of the former Dyeings add

Cutch, 25 lbs.
Quercitrine, 10 lbs.
Hematine, 5 lbs.
Sulphate of Copper, 2½ lbs.

Enter the Cotton at a boil, and treat it as usual; after two hours and a half, take out, drain and air: strengthen the liquor with

Cutch, 25 lbs.
Quercitrine, 5 lbs.
Hematine, 5 lbs.
Sulphate of Copper, 2½ lbs.

Re-enter, handle and boil the Cotton an hour, stay the boil and let it remain in the kettle all night.

In the morning take out; save the Tannin liquor; drain and extract the superfluous liquor from the Cotton, then shake it down for finishing.

Mordant Process.

Bichromate of Potash, 5 lbs.
Solution of Muriate of Tin, 2 or 3 pints.

Enter quickly, and handle lively at a boil-heat; then leave it in the liquor for two hours and a half; take out, wash and dry.

It is optional whether you use two or three pounds of Sulphate of Copper, or the same weight of Potash-sulphate of Alumina in the Mordant; they merely serve to give another tone to the color, and are not essential to the Mordant.

It is to be borne in mind, that too much of any of these other salts be not given so as to overpower the Bichromate of Potash, and prevent it from having its due effect upon the Cutch, which is the most important part of this color.

GREEN.

This color is seldom used alone, or, in other words, as a plain or body color, in the description of goods to which the branch of Dyeing we are treating of, belongs; as very few persons could be found who would of choice wear a pair of green pantaloons: but when printed upon with a small figure and deep colors, it makes a moderate style of fancy wear, but only in demand at intervals.

Its best effects are in mixtures along with other colors with which it contrasts well, throwing into the whole combination a great deal of vivacity and harmony.

An example or two of the different plans on which it can be colored, will be given, leaving its dissimilar shades to be come at by the judgment of the Dyer, who will know that by using more or less Fustic or Logwood, (or otherwise of any other kind of Blue and Yellow coloring matters,) he will obtain lighter, or darker, or deeper hues: and by the relative proportion of one to the other, he will get Bluer or Yellower shades, according to his wish, or to the pattern required.

This color is moderately fast. When properly and carefully Dyed, it will stand the operations of manufacturing and the Fulling Mill very well, but steaming affects it considerably: in other respects it is good.

In the deep shades, a little Cutch, Catechu, Shumac, or any other Astringent matter, either given alone as a Tannin operation, or used with the coloring liquor, serves to increase its permanence, and enables it to resist the steaming better than it otherwise would do. In fact, Shumac can be used very liberally in any of its shades, as it helps in giving the Yellow.

EXAMPLE FIRST.

First Dyeing.

Shumac, 10 lbs.
Fustic chips, 30 lbs.
Logwood chips, 20 lbs.

Bag all these together, and boil one and a half or two hours; then take out the bags, and add

Sulphate of Copper, 5 lbs.

Enter the Cotton and boil an hour, or until the whole is fairly and evenly colored; let it lay four hours if you can, then take out and strengthen the liquor by boiling up in it

Logwood chips, 10 lbs.
Fustic chips, 20 lbs.

After withdrawing the bags, add separately and gradually

Soda Ash, 5 to 7½ lbs.
Sulphate of Copper, 2½ to 5 lbs.

Re-enter the Cotton after these have dissolved and the liquor has ceased foaming; give it a slight simmer, with lively handling for half an hour, and lay down in the kettle all night. Next morning take out and save the liquor for further use.

The second and subsequent Dyeings may be done by the following formula.

Logwood chips, 20 lbs.
Fustic chips, 30 lbs.
Sulphate of Copper, 3 lbs.

Enter the Cotton and treat it as in the first Dyeing, then add

Logwood, 10 lbs.
Fustic, 20 lbs.

After which add separately,

Soda Ash, 5 lbs.
Sulphate of Copper, 2 lbs.

And Dye as above directed for the first kettle-full.

ANOTHER METHOD.

Tannin Process.

Quercitrine, 5 lbs.
Cutch or Catechu, 10 lbs.
Bisulphate of Copper, 2½ lbs.

Dissolve all these together, then enter the Cotton at a boil, which continue for an hour; let it stay in the kettle all night. In the morning take out, drain well and Extract: save the Tannin liquor for other Dyeings.

Mordant Process.

Bichromate of Potash, 5 lbs.
Bisulphate of Copper, 5 lbs.

Dissolve these, then enter the Cotton at a boil-heat, and let it remain two hours and a half: take out, wash well and Extract.

Dyeing Process.

Fustic chips, 30 lbs.
Logwood chips, 25 lbs.

Boil these in the usual manner for two hours; take out the bags and add Bisulphate of Copper, 2½ lbs.

Having the Cotton shook down, enter it at a boil; handle lively and well; in half an hour stay the boil, and let it remain over night.

This method of Dyeing will be successful without employing the Tannin process, but it is far better with it.

The Chrome Green is far superior to the common Green.

You will regulate the shade by the proportions of the quantity of Logwood and Fustic.

PURPLE.

THOUGH this color is not much called for on raw Cotton, and cannot be very highly recommended for satinet and other goods, which require scouring and fulling; it may not be amiss to introduce it for variety's sake, and to show that such a color can be produced, if circumstances require it.

One method of Dyeing it will, therefore, be given; but without either recommending or condemning it, as fit or unfit for any particular kind of manufacture.

Tannin Process.

Cutch. 10 lbs.
Hematine, 5 lbs.
Bisulphate of Copper, 2½ lbs.

Enter the Cotton at a boil, and continue it for one hour and a half; let it stay in all night: in the morning take out, drain and Extract, then shake down the Cotton, ready for the

Mordant Process.

Bichromate of Potash, 5 lbs.
Solution of Muriate of Tin, 6 pints.

Enter the Cotton at boil-heat, and after two hours and a half take it out, wash and Extract.

Dyeing Process.

Logwood, 60 lbs.
Bisulphate of Copper, 2½ lbs.

Enter as quick as possible, handle with spirit; boil half an hour, and let it remain till deep enough in shade.

If wanted a very red purple, use from 10 to 15 pounds of Hypernic wood in the Dyeing process.

BLUE.

THE deepest shades of this color when put through the regular processes of Tannin, Mordant with Chrome, &c., then finished with Logwood, are very beautiful, and equal in appearance the best specimens of the fullest indigo Blue; they resist the operations of manufacturing and the Fulling Mill remarkably well, only losing a little of their *bloom*, which may easily be kept up, when it is desired, by the addition of one-sixth or one-seventh the weight of the Logwood, or Hypernic wood in the Dyeing process. No other method of Dyeing it will produce such beautiful and permanent shades as the one mentioned above; any other plan of coloring it, being merely imitations, in no case equaling it either in richness or durability. There are many shades or varieties of Blue, which are distinguished by different appellations among Dyers, but these shades are only differences in degrees of intensity, gradually diminishing, by using less Logwood, from the deepest Portuguese Blue to a Lavender or Lilac: although the last two shades, especially the latter, might with equal propriety be classed as shades of Purple—their composition colors seeming to be Blue and Purple hues, with the Blue prevailing. They will be treated on, however, in the proper place as shades of Blue, our object under this heading being only to give one or two formula for the deepest Blue.

It will be borne in mind that the Blue of the triple process or Chrome Blue, being the best in all respects, is the one most particularly recommended to your choice.

The other, being a more expeditious method, may answer for some purposes, but not all.

EXAMPLE FIRST.

First Dyeing.

Logwood Chips, 35 lbs.
Bisulphate of Copper, 5 lbs.

BOIL up the Logwood an hour, then withdraw the bags, and dissolve the Sulphate of Copper; enter the Cotton at a boil, and keep it so an hour or an hour and a half, handling well in the commencement; after remaining in as time will admit, take the Cotton out; drain and air well. In the meantime, strengthen the liquor with

Logwood chips, 25 lbs.
Hypernic wood 15 lbs.

Mix these together and bag them; then boil up for an hour and a half; take out the bags and add cautiously and separately (the liquor being below a boil,)

Soda Ash, 5 lbs.
Sulphate of Copper, 2½ lbs.

When these have dissolved, and the foaming of the liquor has ceased, re-enter the Cotton, handle and simmer for half an hour; then stay the boil and let it remain all night, if you think it is not full enough in shade.

On taking out the Cotton, reserve the Dyeing liquor for further use.

In Dyeing a second or more kettles-full, proceed in all particulars as above; only diminishing the quantity of Dyestuffs or varying their proportions if you want a lighter color or a different hue, in which matters your own judgment ought to be the best guide; as the above is not an *infallible rule*, but the generalization of a plan.

ANOTHER METHOD.—CHROME BLUE.

Tannin Process.

Catechu or Cutch, 10 lbs.
Bisulphate of Copper, 1 lb.

Boil the Cotton in these an hour, and after six hours take out, drain and Extract; then shake the Cotton down for the next process.

Mordant Process.

Bichromate of Potash, 5 lbs.
Bisulphate of Copper, 5 "
Potash-sulphate of Alumina, 2½ lbs.

Boil the Cotton in this for half an hour, and let it remain in the liquor all night.

In the morning take out, wash the Cotton thoroughly, and drive out all the water by the Extractor; or otherwise drain in some other manner, most effectually; then shake down well.

Dyeing Process.

Logwood chips, 75 lbs.
Bisulphate of Copper, 2½ lbs.

After boiling the Logwood an hour and a half, and taking out the bags, add the Salt of Copper, and when dissolved enter the Cotton rapidly, and handle a few minutes quickly. As soon as the color has struck evenly throughout, check the boil, or rather stay it entirely, and let the Cotton remain as long as it continues to acquire color.

This color can be Dyed by dispensing with the Tannin process altogether, but is not so good: and it may be varied by using three or five pounds of Hematine in the Tannin process, and deducting ten or fifteen pounds of Logwood from the Dyeing process; and in the Dyeing process Hematine may be used in place of Logwood chips—fifteen to twenty pounds of the former to seventy-five or eighty pounds of the latter; but the formula above given is the most certain means for Dyeing it.

MIDDLE BLUE.

Mordant Process.

Bichromate of Potash, 4 lbs.
Bisulphate of Copper, 3 lbs.
Potash-sulphate of Alumina, 1¾ lbs.

Boil the Cotton in this as usual for an hour and a half; let it lay in all night: in the morning take out and wash well, drain or Extract.

Dyeing Process.

Logwood chips, 50 lbs.
Bisulphate of Copper, 1 lb.

After boiling the Logwood and withdrawing the bags, dissolve the Sulphate and enter the Cotton expeditiously, and handle briskly; bring up the boil for about half an hour, and then leave it till you are assured of the color.

LAVENDER.

Mordant Process.

Potash-sulphate of Alumina, 10 lbs.
Bichromate of Potash, 5 lbs.
Bisulphate of Copper, 4 lbs.

Enter the Cotton into this and boil an hour; let it remain in all night; in the morning wash off and Extract; then shake over very well.

Dyeing Process.

Logwood chips, 30 lbs.
Hypernic wood, 15 lbs.
Bisulphate of Copper, ¾ lb.

After bagging and boiling the Dye-woods for the usual time and taking out the bags, dissolve the Sulphate and then enter the Cotton, and Dye up as in the preceding recipe.

This color being very bright and light, requires smart workmanship in managing it in order to have it all even.

RED.

THIS color is the next in order of succession, and it would be a great acquisition to raw Cotton Dyeing, if we had any materials that would produce it of a sufficient permanence, and at a price corresponding to the requirements of the business; but we have not; it is, therefore, of no use to give recipes for producing it by materials and processes, which, on account of their expense cannot be applied in practice, nor of giving others from cheap materials and simple operations, which though they would produce the Red, it would neither stand the operations of manufacturing, nor the soaps and alkalies employed in Fulling, and in consequence would be totally worthless.

It is true that we could produce it both cheap enough and bright enough by making it with Peach-wood (or other of the common *red* woods,) provided it had no subsequent operations to be exposed to, but we all know that it has, and this very exposure inevitably ruins it.

It could be Dyed a Camwood Red sufficiently bright and durable, but then the action of the Chymical Salts employed in producing the color, would be so destructive to the Cotton fibre, that it would pass no further than the cards, in the process of manufacturing.

The common Madder Red could be Dyed upon it, which would also answer the purpose, but its *cost* precludes the possibility of its employment in practice; and the idea of Dyeing it by the Turkey Red process, is too ridiculous to mention.

Therefore, none of these different kinds of Dyeing will avail us, and in our present state of knowledge, we have no other to fall back upon.

It is, then, as a matter of course, that Red and its shades are, of necessity, excluded from this Treatise.

AURORA.

This color comprises three distinct varieties: the Aurora, or the Nasturtion, the Orange and the Gold: named from the flower Nasturtion, the fruit Orange, and the metal Gold, whose particular hues they are supposed to imitate. They are a compound of Red and Yellow, in different proportions, the Nasturtion having most Red—Gold the most Yellow in their composition; and the Orange, which is the standard or medium shade, having less red than the Nasturtion, and more than the Gold.

None of these shades, in their full perfection, can be applied on raw Cotton, on account of the expense of their materials and operations.

The fast Orange and Gold are produced in great beauty on skein Cotton and Cotton cloth; but the real Nasturtion cannot be reached. It is only on Silks and Woolens that these three shades can be produced with distinctness. and in all their splendor and perfection.

The method of Dyeing Chrome Orange, as practiced with skein Cotton, cannot be applied in coloring the raw material, both on account of the difficulty of the operations, the cost of the materials, and the insuperable objections to working it along with Wool, in the various operations of manufacturing.

We can, therefore, only offer a formula for obtaining a spurious Orange, or rather an imitation of the true Orange; which though neither as permanent or beautiful as the best Orange on Skein Cotton, will nevertheless, in a great measure supply its place, and answer nearly all the demands of this particular species of manufacture. The minor shades of Orange, such as Buffs, &c., will be treated of in their proper place.

ORANGE.

Proto-sulphate of Iron, 10 lbs.
Nitro-muriate of Iron, 2½ pints.

Enter the Cotton at a boil, and continue it until thoroughly saturated with the Iron solution: let it remain a sufficient time to combine with as much of the Mordant as possible; then take out.

Next morning shake the Cotton down, and make a fresh bath with
Annatto, 12½ lbs.
Soda Ash, 10 lbs.
Quick Lime, 2½ lbs.

The Soda and Lime to be dissolved together in the first place, in a barrel of boiling water, which must be allowed to settle, and the clear liquor only to be used with the Annatto.

Enter the Cotton at a boil, which continue an hour. Suit your convenience about taking out; then wash and dry.

This color may be Dyed by Annatto, without the Iron preparation, and frequently is; but it is very fugitive, and not calculated as a color for heavy goods.

It may be Dyed also by Fustic and Camwood; but strictly speaking, this is not an Orange color, although it is very permanent. The above recipe seems to be the most desirable means of procuring the Orange for this kind of work: it may be varied a little from the above formula, by finishing with the Annatto, &c., in the Iron solution.

The minor shades of Orange, such as Buffs, &c., will be found in their proper place of arrangement.

GOLD-ORANGE.

Tannin Process.

Quercitrine, 20 lbs.
Bisulphate of Copper, 2½ lbs.

Enter the Cotton at a boil, and continue it one or one and a half hours; then settle it for the night. In the morning take out and Extract it, leaving the liquor in the kettle. Make a fresh bath for the

Mordant Procees.

Bichromate of Potash, 3 lbs.
Muriate of Tin, 5 pints.

Enter (the Cotton being well opened) at a boil heat: handle well. In two and a half hours take out, drain and Extract.

Strengthen the first liquor for the

Dyeing Process.

Quercitrine, 5 lbs.

Enter the Cotton: boil half an hour: handle well: then leave it in all night: wash next morning. If this be not quite red enough for the pattern you may have to color to, a little of the best Crop Madder may be used to produce that effect.

YELLOW.

THIS is one of the three Simple or Primitive colors, Red and Blue being the other two. These three are the Elements, whose combinations in various proportions form all the other colors. They are the Base of a System of Colors, whose ramifications are clearly and accurately defined in my Treatise on the System and Science of Colors, in this volume.

Yellow is not much called for; its principal use being confined to mixtures, and that in small quantities only: nevertheless, it is necessary to give an account of a method of Dyeing it, as well as other colors, in order to make our arrangement complete.

The color Dyed with Fustic is very cheap, and sufficiently bright and permanent for almost all purposes. It can be Dyed with Quercitron bark, or its liquid or solid extracts; and also with Weld, and various other Yellow coloring substances.

But as Fustic is the cheapest, and is sufficiently bright and durable to answer the purposes of this branch of Dyeing, it will probably be the only article generally employed.

As to Weld or Woald—though it gives the purest and most permanent of vegetable Yellows—its scarcity and price has caused it to fall into disuse, and as there is no probability of its ever being employed on raw Cotton, it is useless to burthen our pages by introducing any account of a method of Dyeing with it. Chromate of Lead might be employed to Dye raw Cotton, Yellow; but that mineral color is not adapted for Fulled goods.

First Dyeing.

Fustic chips, 75 lbs.

BOIL these for two hours; then take out the bags, and add

Bisulphate of Copper, 7½ lbs.

When this is dissolved, enter the Cotton at a boil, and after an hour or an hour and a half's boiling, lay down for the night.

In the morning take out the Cotton, wash and dry. Save the liquor for further Dyeings, as you may color in this liquor steadily without emptying, for a long time.

For the second Dyeing use

Fustic chips, 50 lbs.

Boil as in the first Dyeing, and take out the bags; then add

Bisulphate of Copper, 5 lbs.

Treat it in every respect as in the first Dyeing.

You may take another course in Dyeing by this process—by dividing it into two operations; using in the first dip only two-thirds the whole quantity of the Dyestuffs to be employed; then boiling the Cotton an hour and a half; letting it lay another hour. Take up and strengthen the liquor with the other kind of the Dyestuffs, boiling the Cotton an hour and leaving it in all night.

Though occupying more time and requiring more labor than coloring off at one dip, yet it is the better plan, as the color is richer and more durable than when done at one operation.

You may SPRING the Fustic by giving about two pounds of Soda Ash, with the Fustic, being careful in giving the salt of Copper afterwards.

ANOTHER METHOD.

Bichromate of Potash, 2½ lbs.
Sulphate of Copper, 2½ lbs.
Potash-sulphate of Alumina, 5 lbs.

ENTER the Cotton into this solution at a boil; and after boiling the usual time, let it remain all night.

In the morning take out and wash; then Extract and shake down the Cotton. Make a fresh bath with

Fustic chips, 60 lbs.

Bag the Fustic, and boil it two hours; then draw the bags, and dissolve Bisulphate of Copper, 2½ lbs.

Enter the Cotton; boil an hour, and leave it in all night.

ANOTHER, ON THE SAME PRINCIPLE.

Bichromate of Potash, 5 lbs.
Murio-sulphate of Tin, 3 pints.

Boil the Cotton in this, as in the former process, and wash off. Then make a fresh bath with

Fustic chips, 60 lbs.
Bisulphate of Copper, 2½ lbs.

After the Fustic has boiled for two hours, add the Bisulphate of Copper, and enter the Cotton at a boil, and continue it about one hour at the longest; let it remain all night, and in the morning wash off and dry. There is but little difference in effects between these two plans; some Dyers will prefer one, and same be more in favor of the other; there is more variety than choice in the plan.

STANDARD.

Tannin Process.

Quercitrine, 10 lbs.
Bisulphate of Copper, 2½ lbs.

When these are dissolved, boil the Cotton in them for an hour and a half, and allow it to remain in the liquor as long as time will permit—all night if you can. Take out and drain well, or Extract.

Mordant Process.

Bichromate of Potash, 2½ lbs.
Murio-sulphate of Tin, 3 pints.

Enter the Cotton into this at a boil-heat. After two and a half hours standing, take out; drain or Extract. Shake over, and return the Cotton into the

Dyeing. Process.

Quercitrine, 2½ lbs.
Bisulphate of Copper, ½ lb.

The Tannin Liquor having been strengthened with the above, proceed to Dye, (without boiling,) and let the Cotton remain in this to suit your convenience; or as long as it deepens in shade.

LEMON.

Quercitrine, 5 lbs.
Bisulphate of Copper, 5 lbs.

Boil the Cotton an hour and a half in these, and let it remain in all night.

Half a pound of dissolved Glue added to the liquor before the Sulphate of Copper, will give a *greener* looking hue.

CITRON.

Quercitrine, 2½ lbs.
Sulphate of Copper, 2½ lbs.

WHEN these are dissolved, enter the Cotton, and get it completely wet as soon as possible: then stay the boil, and let it lay as long as the color continues to gain brightness and strength.

* * *

Here ends the Recipes for the Positive or Major Colors. All the other varieties are merely diminutive shades of one or the other of the foregoing Entire Colors.

The remaining Recipes will cover all the inferior shades derived from the preceding Colors, and the two sections of these formula will include every Color, and every shade of Color required in Raw Cotton Dyeing.

MINOR SHADES OF THE POSITIVE COLORS.

THESE shades form three distinct divisions, each of which is as separate and independent of the other as the Black, the Olive, and the Brown, from which they are derived, are distinct from themselves.

Each Division is composed of a variety of gradations or quantities of color, yet each grade bears unequivocal evidence of the original from which it is extracted.

Thus, every one of the Slates point clearly to the Black, as do the Drabs to the Olive, and the Fawns to the Brown, as the sources from whence they separately proceed.

The numerous hues in each of these divisions are principally due to the gradual diminution of the quantity of the original color to which they belong.

They represent three separate Scales of Color, divided into as many parts as there are distinct varieties in their appearance: each variety representing one degree or quantity of color, more or less, than the one preceding or following it, in this apparently graduating scale.

The variety in tone of numerous fancy shades being so great, and such very slight circumstances being sufficient to affect them materially, no positive recipe can be given to Dye to any particular pattern. It is in these minor colors more than in any other, that experience and judgment in the Dyer are absolutely indispensable.

We can only give general formula, from whose results the knowledge of the Dyer must determine what change of the materials is necessary to obtain the particular pattern he requires.

Minor Shades of Black.

SLATES.

THESE shades range from the darkest Slate down to Lead. They vary considerably in the character of their hues, which are determined by the preponderance of one or other of the positive colors of which they are composed, and of the quantity of the whole.

A few specimens will be given.

DARK SLATE.

Catechu, 20 lbs.
Fustic, 10 lbs.
Logwood, 45 lbs.

Treat these in all respects as in Dyeing Black. Add

Soda Ash, 2½ lbs.
Sulphate of Copper, 5 lbs.
Pyrolignate of Iron, 1½ pints.

Enter the Cotton at a boil, and operate exactly as for Black.

You may vary the mode of Dyeing in this case, by dividing the Dyeing into two operations, as follows:

Catechu, 20 lbs.
Fustic, 10 lbs.
Logwood, 20 lbs.
Sulphate of Copper, 4 lbs.

Treat these as usual, and boil the Cotton an hour, and let it lie two hours. Take out: strengthen the liquor with

Logwood, 20 lbs.
Soda Ash, 2½ lbs.
Sulphate of Copper, 2 lbs.

Re-enter and treat the Cotton as usual, and keep it in all night. It is optional whether you use the Pyrolignate of Iron, or not.

LIGHT SLATE.

Catechu, 10 lbs.
Fustic, 10 lbs.
Logwood, 30 lbs.

BOIL these an hour; then give the following, carefully:

Soda Ash, 2½ lbs.
Sulphate of Copper, 5 lbs.
Pyrolignate of Iron, 1 pint.

Enter the Cotton and Dye as usual, and leave in all night.

LEAD.

Logwood, 30 lbs.
Catechu, 5 lbs.
Soda Ash, 2½ lbs.
Sulphate of Copper, 5 lbs.
Pyrolignate of Iron, 1 pint.

After boiling up the Logwood and Catechu for an hour, add separately and carefully the Copper and the Iron Mordant, having previously boiled the Soda with the Dyestuffs.

In Dyeing, treat this as for the Slate in all particulars. Any variation from these shades will be obtained by different proportions and quantities of the several kinds of Dyestuffs mentioned in the recipes.

If they are wanted to incline more to the Black, use more Logwood; if more to the Olive, use more Fustic, and if more on the Brown hue, give more Catechu: but, as before said, you have to depend upon your own knowledge in these matters.

Minor Shades of Olive.

DRABS.

THESE shades embrace all the different kinds of Drabs, and they form a very great number of dissimilar hues, but which are all produced by the difference in the several proportions and quantities of the same Dyeing materials.

A few examples only will be given, as the Dyer's ingenuity is here called into requisition, no recipes being adequate to directing him how to produce such and such and such a shade—his own experience is the sole guide.

We can give recipes for the medium and extreme shades, which is all the aid we can offer him.

DARK DRAB.

Catechu, 25 lbs.
Logwood, 15 lbs.
Fustic, 10 lbs.

Boil these for an hour, or until the Catechu is all dissolved. Take out the bags, and add

Sulphate of Copper, 3 lbs.

Enter the Cotton, and after an hour's boil, throw on by portions two pounds of Sulphate of Iron—handling all the time—the Sulphate being previously dissolved in a barrel of the Dyeing liquor. Let it remain in all night.

This may be colored by letting it remain in the kettle all night, with every thing in the composition of the liquor, excepting the Sulphate of Iron; and in the morning passing it into a fresh bath of cold or lukewarm water, with the Sulphate of Iron—or, instead thereof, two pints Pyrolignate of Iron.

STONE DRAB.

Catechu, 12½ lbs.
Logwood, 6 lbs.

BOIL these as usual, and then add to the liquor

Sulphate of Copper, 1½ lbs.

Enter the Cotton; boil an hour, and then throw on Sulphate of Iron two or three pounds, as before directed.

RED DRAB.

Catechu, 20 lbs.
Sulphate of Copper, 3 lbs.
Sulphate of Iron, 1 lb.

When these are dissolved, enter the Cotton; boil an hour or more, and let it remain all night.

SILVER DRAB.

Catechu, 5 lbs.
Sulphate of Iron, 2½ lbs.
Sulphate of Copper, ½ lb.
Hematine, ½ lb.

When these are all dissolved, enter the Cotton, and proceed in the regular course of Dyeing.

You will bear in mind that all these colors, from Catechu or Cutch, continually rise fuller and redder with age, fulling, and other operations of manufacturing. They ought to come up much uller when finished in the fabric, than when fresh Dyed.

Minor Shades of Brown.

FAWNS, BUFFS, ETC.

THERE are quite a number of shades going under this name and that of Buffs. They run down from a Cinnamon to the lightest Buff, in a gradual recession of lighter hues.

They are very permanent colors, and can be recommended as the most durable and cheapest shades on raw Cotton.

DEEP FAWN.

Cutch, 25 lbs.
Quercitrine, 5 lbs.
Hematine, 2½ lbs.
Bisulphate of Copper, 5 lbs.

Dissolve all these together; then enter the Cotton at a boil, which continue one hour and a half. Leave in all night.

In the morning take out, and drain well or Extract. Save the liquor, and make a fresh bath with

Bichromate of Potash, 2½ lbs.

Enter at a boil heat. Handle and take out after two hours' time.

If not full enough for the pattern, return into the first kettle, and let it remain at a boil-heat an hour or two. Wash off well.

FAWN.

Catechu, 12½ lbs.
Bisulphate of Copper, 2½ lbs.

BOIL the Cotton in this, as usual, and keep it in all night. In the morning take out, drain, &c.; then a fresh bath with

Bichromate of Potash, 2½ lbs.

Enter at a boil-heat; when, after standing two hours, it is finished.

ANOTHER FAWN.

Catechu, 6 lbs.
Bisulphate of Copper, 1½ lbs.

Treat the Cotton as in the other cases; then finish in a fresh bath, with

Bichromate of Potash, 1½ lbs.

Enter the Cotton at a boil-heat; handle, and then leave it at this heat for two hours, or two hours and a half. Take out and wash off.

LIGHT FAWN.

Catechu, 5 lbs.
Ground Camwood, 5 lbs.

Boil these well for one hour; then enter the Cotton and boil it for two hours. In the meantime dissolve in a barrel of the Dyeing liquor

Bisulphate of Copper, 1½ lbs.

Throw this solution over the Cotton by degrees, whilst boiling; handling well for half an hour; then let it remain all night.

NANKIN.

Mahogany saw-dust, 25 lbs.
Lime-water, 5 gallons.

Boil the Mahogany up first for an hour; then add the Lime-water, and color as for the other Fawns.

This is only introduced for the reason that it gives a shade not to be obtained by other Dyestuffs, and may be, in some particular cases, desirable.

It is very simply Dyed, and its materials are cheap.

FULL BUFF.

Sulphate of Iron, 10 lbs.
Nitro-muriate of Iron, 2½ pints.

Boil the Cotton in this solution until saturated with it; then let it remain for two hours without boil. Take out, drain and Extract. Then make up a fresh bath, with

Soda Ash, 10 lbs.
Quick Lime, 5 lbs.

Dissolve these in a barrel of boiling hot water; let it settle; then take the clear liquor only for use, and when the bath has come to a boil-heat, enter the Cotton expeditiously, and handle lively; after an hour's time take out, drain well and air; then re-enter into the first kettle or Iron solution, at a boil-heat, handling it till even throughout: let it remain an hour longer: take out, drain and air it until the color has fairly come up through the whole Cotton; then wash off well before drying.

ANOTHER BUFF.

BOIL the Cotton an hour and a half in a liquor made with

Sulphate of Iron, 10 lbs.

Take out after it has lain in this two or three hours, and give it a fresh bath with

Soda Ash, 5 lbs.
Quick Lime, 5 lbs.

Treat the Soda and Lime as directed above; then after the Cotton has been drained or Extracted, enter at a boil-heat: after an hour take out, drain and air well; then wash off well before drying.

BRIGHT BUFF.

Nitro-muriate of Iron, 1 gallon.

After boiling the Cotton in this as usual, and letting it remain all night—if convenient—take out and drain: shake over and enter into a fresh bath, made as follows:

Soda Ash, 5 lbs.
Quick Lime, 5 lbs.

Treat these articles as before mentioned, and enter the Cotton in the usual manner, at a boil-heat, and after leaving it therein for an hour, take out, drain and air well; then wash off.

CHROME BUFF.

Protosulphate of Iron, 15 lbs.

Enter the Cotton into this at a boil, which continue for an hour or more; then let it remain as long as convenient before taking out. Drain and air well.

Soda Ash, 10 lbs.
Quick Lime, 5 lbs.

Treat these as before stated, and making a fresh bath with them, enter the Cotton at a boil-heat, and keep it in an hour. Take out, drain and air it sufficiently to oxydize the Iron; then wash well, and drain or Extract.

Bichromate of Potash, 2½lbs.

Enter the Cotton into this fresh bath at a boil-heat; keep it one hour and a half; take out, air and wash.

TREATMENT OF THE COLORS AFTER DYEING.*

The preservation of the colors after they are produced, is a matter of interest to the Manufacturer as well as to the Dyer; and, therefore, every precaution ought to be taken to ensure this end in their passage through all the stages of Manufacturing.

It is a thing that has been very little attended to or thought about: nevertheless, it is of the utmost importance; for it is of little use for the Dyer to exert his skill, and exhaust his care and patience in producing the best specimens of his Art, if these are afterwards to be deterioated, through the carelessness or ignorance of any of those who have the charge of conducting the several processes which they are exposed to, in the course of their conversion into a finished fabric.

It must be remembered, that *Colors* are not *indestructible* or *unchangeable* substances; but that, on the contrary, they are, most of them, very susceptible of change or alteration by the action of several substances and operations: and it is not what the color is, when it comes from the hands of the Dyer, but what will it be, when it leaves the Manufacturer as a marketable article, that we have now got to consider.

The most trying process to which colors are exposed, is that of Scouring and Fulling, upon which it will be particularly necessary to comment, as the principal mischief to colors on Cotton when mixed with Wool, are clearly traceable to this source.

The friction and chafing of the Fulling Mill or machine—independent of any other cause—impairs the Cotton-colors materially; but of this effect the Fuller must be exonerated from all blame—as it is indispensable to the felting of the cloth—or, in other words, to the interlacing of its fibres, which constitutes the act of Felting or Fulling.

But it is to the injudicious use of the Alkalies or Soaps employed in Scouring and Fulling, that the most destructive effects are attributable, and for this part of the mischief, the Fuller—in a great measure—stands responsible.

It is by employing an excess of Alkali, or by the use of super-alkaline soap in Scouring or Fulling (in the last instance the Soapmaker is to blame,) from which the most deleterious results ensue.

Alkalies, or Soaps with alkaline excess, not only change the hue or tone of the color, but by the heat, the friction, and the caustic nature of those articles, dissolve a portion of all Cotton-colors, and, in some cases, totally destroy them.

The worst of these effects can be avoided; and it is the duty of the Fuller, and the interest of the Manufacturer, to see that they are avoided.

The common and great fault in this operation, is a continual inclination on the part of the Fuller (generally speaking,) to make strong alkaline or soapy solutions for Scouring—than which, nothing can be more erroneous.

The strength of the solution, or the quantity of Alkali employed in Scouring, should just be sufficient to combine with and start the oil from the goods, and no more. Anything more than this is a waste of Alkali, and an injury to the color and the goods; this can be regulated by an intelligent Fuller with the greatest nicety, and ought, in all cases, to be so.

And in addition to this, uniformity of Alkaline strength at all times is required, and should be maintained: also, one certain and uniform kind of Soap should be purchased, and used at all times; and then, the ease, certainty and economy of the Scouring and Fulling, and the preservation of the colors are always ensured.

In the article of Soap for Scouring and Fulling, there is always a discrepancy, not only between the Soaps made by different Manfacturers, but in the Soap made at different times by the same Manufacturer; hence arises the principal difficulties the Fuller has to contend with.

The differences in these Soaps originate from the fact that the major part of the Soap-makers are ignorant of the kind of Soap required for this purpose, and are not fully aware that uniformity of the article is an indispensable requisite in order to produce the same effects, at sundry and distant times.

There are two things necessary in manufacturing Fulling Soaps: a freedom from all excess of uncombined Alkali, and an uniformity of composition in the quantities of its constituent parts, in every separate installment.

I do not know but one Soap Manufacturer, who steadily and systematically adheres to those requisitions (for colored goods,) but who, having been practically acquainted with the nature of Fulling, is, therefore, well qualified, both by experience and information, to supply an article that will answer all the requirements of this business.

The Manufacturer of Soap alluded to, is Mr. Joseph Rollinson, of Willimantic, Connecticut; with the properties of whose Soaps I am well acquainted; and I can confidently recommend them, both for cheapness and efficiency, as superior to any other for Fulling either white or colored goods.

CONCLUDING OBSERVATIONS.

INJUNCTIONS OF DYEING.

It will be seen, by a careful examination of the preceding pages, that, in Dyeing Raw Cotton, we have to observe and adhere to the following particulars, as positive injunctions at all times:

1st.—To have the Dyeing liquors perfectly clear solutions.

2d.—Always to have the Cotton well opened, or shook down, before entering it into the kettle.

3d.—To enter expeditiously, and to get every portion of it equally imbued with liquor, as soon as possible.

4th.—To let the Cotton remain in the Dyeing liquor, as long as convenience will allow.

5th.—Between every Dip to give sufficient time to drain and air well (and Extract—if you have got any machine for that purpose.)

6th.—To carry none of the liquor (in the Cotton) of one Dip into that of another and succeeding fresh bath.

7th.—Not to give too long or excessive boiling, after the Cotton has once been wet.

8th.—In all cases when necessary to wash between any of the stages, or separate and distinct processes of the Dyeing, always have the Cotton drained and aired before washing, and the same after washing, before re-entering it into another liquor. By taking a great quantity of water in the Cotton into the next bath, you will, of course, weaken the solution, and prevent the Cotton from absorbing the contents of the bath effectually. As before said, the freer from liquid the Cotton is, on going into any of the Dyeing liquors, the more of their properties it takes up.

METHODS OF DYEING.

There are four distinct Methods, Modes or Plans of Dyeing on raw Cotton, which are dictated either by the nature of the particular color or by other necessitous circumstances.

1st.—Aggregate Dyeing:—when all the coloring materials are mixed together in one common bath, and the Dyeing performed at a single Dip, or immersion.

2d.—Duplicate Dyeing:—when the first method is divided into two Dips, where two-thirds of the whole quantity of the Dyestuffs are used in the first, and the remaining third in the last Dip.

3d.—Preparation Dyeing:—when the Dyeing is performed in two separate baths; this being generally the Tannin and Mordant processes, the Tannin first: or the Mordant and Dyeing processes, the Mordant first; and in some cases a return into the first bath.

4th.—Complete Dyeing:—when all the above methods are combined; divided into three stages, the Tannin, the Mordant and the Dyeing process, each in separate baths.

The way of conducting these several methods, and the colors for which each method is most particularly adapted, are laid down with the recipes for each separate color: but any intelligent Dyer will readily perceive how he may deviate in any manner from these plans, according as surrounding circumstances may impel him.

The quantities and kinds of the Dyestuffs in all the recipes are reduced to one common standard, or per centage, namely: each Formula is calculated for one hundred pounds of Cotton or Cotton Waste: so in Dyeing any other quantity (less or more,) you will have to proportion each of the materials in a decreasing or increasing ratio, from or by that standard.

As the several Chymical Salts, or those metallic and earthy compounds which form the base of the colors—otherwise known as Mordants, are set down by their Chymical terms—an alphabetical explanation of them, along with other techinal terms, will be given for illustration, which see.

EXPLANATION OF CHYMICAL AND TECHNICAL TERMS, USED IN THIS WORK ON DYEING.

A

Astringent: a general term for such Dyestuffs as contain the Astringent principle, or are possessed of the property of astringency; such as Shumac, Nut Galls, Catechu, &c., &c.

Astringency: The property of an astringent.

Astringent principle: the same as Tannin (which see.)

Affinity: a liking for, or a tendency to combine with.

Aqua: water: Aqueous Tincture: a watery solution of any Drug or Dyestuff.

Axiom: a self-evident proposition: a positive demonstration.

B

Bath: the liquor of any kettle, &c.

Bichromate of Potash: Chrome.

Bisulphate of Copper: or, *Sulphate of Copper by Dyers:* Blue Vitriol.

Braziline: the solid extract of Brazil wood: Hypernic, Lima, or Nicaragua or Peach wood.

C

Color: a term used synonomously to express the coloring liquor: the color on the fabric: or the the composition of a color.

Cropped: the shearing of a certain portion of the nap, before Dyeing.

Crop-Madder: the best description of Dutch Madder—of which there are four qualities, known in commerce by the names of Crop, Gammene, Ombreau and Mull.

Cuttle, or *Cuddle:* to list up, or fold up in a straight and even manner, the cloths for coloring.

D

Dip: immersion: the act of exposing the Cotton, &c., to the action of any of the Dyeing liquors.

Draft: in Piece Dyeing, one length or *string:* where there are two Drafts it signifies that the whole number of cloths Dyeing at at a time are divided into two equal lengths, and run parallel to each other over the reel.

E

Extractor: a machine made to revolve at a great speed, in order to Extract all the liquid out of Wool, Cotton or Cloth.

Extract: to Extract: implies the use of the Extractor.

Extract: an Extract: the liquid or solid color obtained from the *rough* Dyestuffs, woods, &c.: such as Quercitrine, &c.

End: in Piece Dyeing, the passage of the cloth over the reel, or from one roller to another, is termed *giving it an End.*

Extract of Indigo: this is a fictitious term, applied to the Soda-sulphate of Indigo; which is also called Indigo Paste.

F

Formula: the manner or fashion in which the Recipes are set down: the Recipe, or its form.

H

Hematine: the solid coloring-matter of Logwood, commonly known as Extract of Logwood.

Heat: hand-heat: just as hot as the hand can bear to be passed through the liquor. Temperature 140 deg.

Heat: boil-heat: about the boil, but not in ebullition. Temperature, 200 deg. Fahrenheit.

Hypernic Wood: a red Dye Wood, sometimes called Lima wood.

I

Indigo Paste: erroneously called Extract of Indigo: the Soda-sulphate of Indigo.

K

Kettle: a metallic vessel used in Dyeing, when fire is applied direct: but when steam is used, wooden vessels are substituted for it. In this work, the term kettle, tub, box, vat or vessel are used indifferently, as implying the same thing, viz.: a vessel for coloring in.

M

Muriate of Tin: a saturated solution of Tin in Muriatic Acid.

Murio-sulphate of Tin: a solution of Tin in a mixture of Muriatic and Sulphuric Acids—the Muriatic Acid being in excess.

Murio-nitrate of Tin: a solution of Tin in a mixture of Muriatic and Nitric Acids, the Muriatic Acid being in excess.

Muriatic Acid: an Acid obtained from common, or from sea Salt, by distillation with Sulphuric Acid.

Mordant or Mordaunt: any one, or a mixture of several of the Chymical Salts used in Dyeing, is the Mordant or base of the color; it is either applied before the coloring matter, or at the same time, or after the coloring matter has been worked on. In the latter case it is called *Saddening.*

Machine: an apparatus for Dyeing this kind of cloth, and described in the article "Dyehouse," in the second section.

N

Nitro-muriate of Tin: a solution of Tin in a mixture of Nitric and Muriatic Acids; the Nitric Acid prevailing.

Nitro-muriate of Iron: a solution of Iron in Nitric and Muriatic Acids; the Nitric Acid being in excess.

Nitro-sulphate of Iron: Nitric Acid saturated with Iron and sulphate of Iron.

Nitric Acid: an acid obtained by distilling Nitrate of Potash (Nitre or Saltpetre) and Sulphuric Acid together.

Nap or Napping: nap: the fur of the cloth: *to nap,* the act of raising the fur: *napping,* the same.

P

Potash-sulphate of Alumina: in Dyeing, Alum, or Sulphate of Alumina.

Potash: A strong caustic Alkali.

Proto-sulphate of Iron or Sulphate of Iron: in Dyeing, Copperas.

Pyrolignate of Iron: a brown liquid solution of Iron in Pyroligneous Acid: vaguely and improperly called Iron liquor.

Pyroligneous Acid: literally Fire or Burned wood Acid: an Acid obtained from wood by the process of Destructive Distillation.

Q

Quercitrine: the solid Extract of Quercitron Bark, commonly called Yellow Oak Bark, which is erroneous; it is the bark of the *Black* Oak—the "Quercus Nigra" of Linnæus.

R

Raise or Raising: to bring up, either in reference to a color, or the temperature of a Dyeing bath. Also, to raising cloth on to the Reel, or Wool out of a kettle.

Run: to pass through the Dyeing liquor.

Reel: the same as whinch: a frame with four wings from an axle, which stands on supports on each side of the Dyeing vessel; and is made to revolve by a crank, attached to one end of it.

S

Salts or Chymical Salts: any crystalized body, capable of solution, is a Chymical Salt.

The Salts employed as Mordants, in Dyeing, are of two kinds: the simple and compound. The simple is some substance that assumes a crystaline as its common shape—such as Tartaric and Citric Acids. The compound are composed of two or more substances in Chymical union—such as Sulphate of Iron, and Potash-sulphate of Alumina. The term Salt, in the strictest sense, seems to apply almost exclusively to the latter class.

Shoddy: all kinds of woolen rags *deviled* up into wool again, and then re-manufactured into cloth.

What a specimen of honesty! What a superiority over foreign manufacture is this!

Scray: a moveable platform with open-worked top, for the convenience of draining the Cotton, &c., and moving it from one place to another.

Standard: an upright support: a test.

Standard Liquor: steady, enduring.

Standard Color: the medium, or Test color: the central or focal color, or liquor.

Strike: in Dyeing, the act of the color, combining with the article to be colored: for instance, to say, "It *strikes* quick," is synonymous with "It colors rapidly."

Super-tartrate of Potash: the same as the Bitartrate of Potash or tartrate of Potash: Cream of Tartar, of which the common, or red Tartar, called Argol, is a crude specimen.

Soda-Ash: a crude, rough, caustic Alkali.

Sal-Soda: a crystalized Carbonate of Soda: milder and purer, and not so caustic or corrosive as the Soda-Ash.

Shift or Shifting: to *shift* a kettle is to change its liquor, or otherwise draw it off.

T

Tannin: a vegetable principle, existing in a variety of different substances employed in Dyeing, and for other purposes. Catechu and Cutch contain more of it than any other matters, in proportion to their weight. It is that property of Barks, &c., which converts Raw Hides into Leather, in the art of Tanning: hence its name.

It is the same thing—under another name—as the Astringent Principle.

Tannin Process: in Dyeing, the first step or preparatory stage in Cotton Dyeing—generally termed Shumacking.

W

Winch or Whinch: the same as Reel.

SECTION SECOND.

PIECE DYEING.

The Methods of Dyeing all Colors. in the Piece, on such Cloths or Fabrics as are Composed of Cotton and Wool, or Woolen Waste and Cotton together.

THE ADVANTAGES OF PIECE DYEING.

PIECE DYEING for self-colors, on the low-priced goods, made by a mixture of Cotton and Wool, or of Cotton and Woolen Waste, Shoddy, &c., is far better adapted to answer the purposes of the Manufacturer, than coloring the Stock in the raw state.

This method possesses many advantages over Dyeing the Cotton, the Wool, or the Waste, before manufacturing it.

In the offset, the Stock can be immediately on its arrival at the establishment turned to account, by being put into progress of manufacturing; and in the un-Dyed state, it is manufactured with less difficulty, with more cleanliness, and with less waste of Stock, than when previously Dyed.

A greater quantity of Cloth can be got off in the same time, when worked in the White, than can be done, by operating on it when colored: for the reason that it Cards, Spins, and Weaves better, and the Operatives can see more clearly how to manage it; especially by artificial light, or in bad weather.

The White work takes less Oil in the Carding, and less Soap in the Scouring and Fulling; and in every stage of its manufacture, it possesses economical and other desirable advantages over the Colored work, which must be well known to every experienced Manufacturer.

There is another and important advantage derivable from Coloring in the Piece: that is, the Manufacturer can at all times expose in the Market a variety of Colors, in greater or smaller quantities, and thus secure customers; when another, having only one Color to choose on, cannot, perhaps, suit the Purchaser. He can also be prepared, when a change of Colors (which is frequently the case) takes place in the market, to meet that demand in three or four days; whereas, in the other case, it would take him two or three weeks, probably, before he had the goods ready for sale, and then, perhaps, he would be too late—the cream having been taken off the milk by another, who was prepared any day for whatever change the versatile mind of the public might think proper to make.

Looking at these advantages, it seems at first view very surprising that Manufacturers should continue up to the present time to color their Stock before working it, when the other course is more advantageous in every respect: but the surprise ceases, when we consider that they have hitherto been limited to one Color only in Piece Dyeing.

I am not aware of any other Dyer having attempted, certainly none have succeeded, in Dyeing the Cloth any other Color than Black, upon this kind of Goods.

Therefore, in laying before Dyers and Manufacturers my plans for Dyeing all the colors in the piece, I think I am conferring an especial favor upon them, which any pecuniary recompense I may receive will never repay me for the labor and sacrifice I make, in thus giving out of my possession valuable and important information, which they cannot derive from any other source. My desire to extend the knowledge of a species of Dyeing, so much needed at present, and a little personal ambition, withal, has been a greater inducement to me to make this business known, than any expectation I have of ever receiving any financial remuneration from its publication.

OBSTACLES TO DYEING IN THE PIECE.

THE greatest difficulty experienced in Dyeing these kinds of goods in the piece, arises from the two-fold nature of the materials that compose them; and neither of the plans for Dyeing all-Wool or all-Cotton cloths, will answer for this mixed fabric. It must have a plan peculiarly its own, which will be found in its mode of operation, to differ materially from either of the other two.

It is, comparatively speaking, no very hard task to Dye either Wool or Cotton cloth when separate, but when the two articles are mixed together, their different affinities for color produce a neutral state of attraction (for color) which requires to be met by substances and operations that will Dye them equally alike, when exposed together under the same circumstances in one common liquor. This cannot in all cases be accomplished, but in the Recipes about to be given, this desideratum will be found very closely approximated.

Considerable difficulty, also, results from the slovenly and hasty manner in which they are manufactured, especially in the Carding; this branch of the manufacture, in which the utmost nicety and care are required, to mix the Cotton and Wool perfectly together, is generally *rushed* through the cards, as though the whole stock was the coarsest and openest kind of Wool; and the consequence is, that the Cotton is distributed in flakes, which in the act of Fulling roll up into hard, tight, knotty balls, which are almost impossible to penetrate by any substance or any method of Dyeing.

Whereas, it actually requires better Carding than the finest Wool, to effect a perfect mixture of the two materials, and leave an even and smooth face, and a perfectly even and solid color, when the goods are finished.

It is on the coarsest qualities of Stock, where the Carder experiences most difficulty, in making a perfect mixture of the Cotton and Wool; for the difference in fineness and length of staple between the two articles, prevents their intermixing fibre for fibre—an arrangement so much required, in order to make one homogenous fabric of the whole.

It is only where the two materials nearly approximate in the quality of the fibre, that we can look for their easy and thorough mixture; hence better results will follow from mixing Cotton with the finest Wool, rather than the coarsest. In plainer terms, we ought to say, that the rascality of this kind of manufacture will be harder to detect in fine goods than in coarse.

Any grease or soap left in the pieces, are a deadly obstacle to their coloring; therefore, in Scouring and Fulling, care should be taken to clear them well out, before sending them into the Dye-house. All the raising or napping they require, ought to be done before they are Dyed: and they should also be dry-cropped before coloring. The reasons for this treatment are plain, for if they have to be again raised after Dyeing, the friction of the Gig or Napper, scrapes off the color from the Cotton, and makes the whole face of the cloth look gray and bare in color; and if Dyed without Cropping, the quantity of Nap left on acts as a filter to the color, and prevents it from penetrating the body of the cloth; and consequently when this Nap is afterwards cut off, the color is much lighter than expected; the best part of the color having been carried away in the shearing of the Nap. From these observations, it is clear, that before commencing to color this kind of cloth, it ought to come from the hands of the Manufacturer in the following style, to insure the best results of Dyeing.

In the first instance, it must be thoroughly Carded; (this is the most important point in the whole manufacture of these fabrics;) next, the pieces must be thoroughly scoured, leaving neither grease nor soap in them after they have been washed from the Fulling: then they must be fully raised at the Napper or Gig, and steamed if required, so as to require none after Dyeing, and finally dry-cropped, low, and sent dry to the Dye-house. These essential points are indispensable to the complete success of the Dyeing, which the Dyer, for his own credit, will do well to look after.

After the Dyeing, the only work that ought to be given them, is to wash off in water; then smooth the Nap, Tenter and Finish them.

It is a common practice to take them for Dyeing immediately after the wet-raising, and without any Cropping; but this is a foolish way of proceeding, as the color has no chance to ground the cloth in Dyeing, and afterwards the greater part of it is sheared off with the body of the Nap.

THE DYE-HOUSE.

THE DYE-HOUSE described in the First Part of this work will answer in all respects for Cloth Dyeing, provided you are going to color entirely with Reels or Winches: in that case, all you would have to do, would be to fix the Reels over the Kettles or Tubs, and the place would be ready to commence Coloring in.

But if you are going to Dye, or only *part* Dye, by a Geered Apparatus, then it would be necessary to fix a Machine in place of one of the Kettles or circular Tubs, made after the following fashion: a Box, six feet in length, four and a half feet in depth, four feet in width—all inside measurement—on the top of which have four strong, upright supports, two on each side, and fifteen inches from the ends—these being to bear at fifteen inches from the top of the Box, two wooden rollers, of three or four inches diameter and four feet long, to lay crosswise, the length of the Box: at one and the same end of each roller have a cog-wheel of about twelve inches diameter, and below that a driving-wheel of three or four inches diameter: these wheels to be stout made, and their axles made stout, and firmly set into the Rolls: in the inside of the Box, at six inches from the bottom and two feet from each end, have two smaller rolls, placed so as to revolve freely: midway between these two rolls, on the top of the Box, fix an upright standard on each side, about six inches in height, to support a small, open reel, of eight or nine inches diameter. All these rolls, and the small reel or winch, are to lie perfectly parallel to one another, across the length of the Box: and all of them to be on a true horizontal level—they and the Box to make one complete Machine—firm, true, compact in all its parts, and steady and certain in all its movements. Attach a leader of Drilling to each of the two upper rolls, of sufficient length to pass from them under one of the bottom rolls, from that over the top of the small reel on the centre of the Box, and from that to pass under the other bottom roll, and then up to the top of the Box, with about a yard allowance of spare Drilling. The apparatus is now ready for use. Such a Machine is calculated to color twenty-four pieces per day, of twenty-five yards each.

The object in constructing a Machine after this principle, is to give the Cotton and the Wool an equal chance of taking the Color alike, and to meet those separate but dissimilar circumstances, under which each of them combine with Color.

Cotton only takes up a small quantity of Color at a single immersion, and takes it up quickly, and requires to be aired before another Dip is given to it, when it re-Dyes as before, until it has acquired, by repeated Dips and airings, by the same liquor, a sufficient depth of shade.

Wool, on the contrary, takes up the Color as long as it remains immersed, without exposure to the air; therefore, when the Cotton and Wool are both exposed for a long time in the same liquor, the Wool will be fully colored, and the Cotton will be only partly so. The Machine described above, meets the demands of these two cases; for the Cotton, as the Piece passes from one upper Roll through the liquor to the other, gets two Dips and one airing, between, as it passes over the small Reel, above the center of the Box, and by the time the Cloth has run three times from Roll to Roll, the Cotton is Dyed full us deep as the Wool.

GENERAL DIRECTIONS FOR DYEING COTTON AND WOOL CLOTHS.

THE most important object in Coloring these kinds of Cloths in the Piece, is, to make sure of Dyeing the Cotton deep enough, in the first place; after that is accomplished, we may easily bring up the Wool at our leisure. As Cotton absorbs most coloring-matter when exposed to it in a dry state, we ought, therefore, to have the Cloths *dry* when commencing to Color them, if we intend them to have every chance they ought to have.

The best general plan of Dyeing these goods, is, first, to give them the Tannin Process or *Shumacking*, at a hand-heat, leaving them in all night: next morning, after draining well, pass them for an hour or an hour and a half, through the Mordant, at a boil-heat: after airing awhile, they should, in most cases, be washed and well drained: by this course a good foundation is given to the Cotton, and it will take the Color afterwards as readily as the Wool: they are finished in the Dyeing Process, by beginning at a heat considerably below the boil, and bringing up gradually to a boil, of which they ought not to have much.

This plan is the most natural and straightforward, especially when you have to depend upon the Reels, entirely: but the plan can be reversed, if you have not convenience for washing off between the operations; in which case you must Color up in the Dyeing Process first; then Shumac at a hand-heat, if for Dark Colors, and at lukewarm or even cold, if the Color is very Light, (in this, experience must guide,) and in either case, leave in all night: in the morning, Mordant with Nitrate or Pyrolignate of Iron, at a hand-heat for Dark, and perfectly cold for Light Colors. Wash off, when convenient, and they are finished.

The common plan adopted by the generality of Dyers in Coloring Black (the onlyColor they attempt to Dye), is to Color *first* in the Dyeing liquor with the Rolls; then to give about an hour's boil in another bath of Shumac, Pyrolignate of Iron, &c., and then a return to the Rolls and the Dyeing liquor, which has been strengthened by the addition of Logwood, &c.

This method of proceeding is not very objectionable, but either of the others are preferable, as by keeping the several liquors separate, a more intimate combination of the Cotton and the Color takes place, and it is also a cleaner, faster, cheaper and more desirable Color.

But, whatever method of Dyeing is pursued, the goods ought in every case to be well drained and aired, before going from one liquor or kettle into another.

In managing the Pieces, either in the kettles or the Machine, let them go into the liquors in as straight a manner as possible, and keep them so whilst in the act of Dyeing; and always have them nicely folded up while resting for drainage, &c., and send them out of the Dye-house in a neat and workmanlike manner.

Although these goods can be Dyed entirely with Reels, and without the use of the Machine or Rollers, yet the last is decidedly the best method in every respect for the Dyeing Process. Those who have not a desire to try such an apparatus as has been described, may easily convert one of their larger kettles into a substitute for it, by fixing the Rollers into a moveable Frame, that may set into the kettle when wanted for Cloth-dyeing, and be taken away when Cotton or Wool is to be Colored, but the draft of the one mentioned above will be found the best.

THE RECIPES.

Each of these Formula are calculated for six Pieces, or one hundred and fifty yards when the Machine is used, and for eight Pieces or two hundred yards when they are Dyed with the Reels, without using the Machine at all: some of them will be given for coloring off at one operation only: others at two, and some at three.

In making up all or any of the liquors according to the Recipes given for each, care must be taken to have all the solutions, when ready for the Cloth, entirely free from ground or chipped Dyestuffs, or any undissolved coloring-matters; the liquors must be of one clear and uniform consistence, all the materials of the bath being held in solution. Where Shumac and other ground Dyestuffs are obliged to be used, it is best to boil them out in some other convenient vessel, and add the clear liquor to the Dyeing bath: but it is far more convenient, where it is practicable, to use only the liquid or solid extracts of the Dyestuffs; in this case the Dyeing liquors can be kept at one strength, and in a clear state for an indefinite length of time, though Coloring in them daily.

Wherever the Recipes are given for Dyeing with the Reels entirely, this same Recipe will answer, if you use the Machine for the Dyeing Process, only charging the Machine with double the quantity of materials for the first Dyeing, that you employ afterwards for succeeding colorings, and that quantity is the same as laid down for the Dyeing Process with the Reel. The reason for giving recipes for Dyeing with Reels, is to give those a chance of producing these Colors, who may not have the facility of a Machine. They can be Dyed in all their processes by common Kettles and Whinches, or by the Machine. The latter is the best, for many reasons: but it must be understood in all cases, that the Machine is only employed in the Dyeing or Coloring Process; the Tannin and Mordant Processes always being performed with Kettles or Whinches.

All the Colors, it will be observed, are Dyed upon one common principle, that is, as far as the Cotton is concerned; an astringent element of some kind being required, either in a distinct process, or by mixing it with the other materials in the Dyeing Process. This is the foundation upon which this kind of Dyeing rests: the Cotton in all cases requiring an intermedial substance that possesses the quality of attraction both for the Cotton and the Color.

The Processes of Tannin and Mordant are chiefly performed cold or lukewarm, the object in most instances being to impregnate the Cotton part only, with this preparation, leaving the Wool to color up in the Dyeing Process: but when we wish to give the Wool a slight touch of the preparation, we must use the baths at about one hundred and seventy degrees, Fahrenheit, more or less, according to the nature of the Color, and other circumstances.

The Pyrolignate of Iron is chiefly mentioned in these Recipes as the Iron Mordant, for most of the Colors, but if the goods be of fine texture, the Nitrate, Nitro-muriate or Nitro-sulphate of Iron may be substitued for it, if there be any objections to the use of the Pyrolignate on account of its empyreumatic smell.

BLACK.

WHEN this Color is properly Dyed upon Cotton and Wool goods, they look remarkably well, and by a superficial observer would scarcely be distinguished from all-Wool, provided they have been well manufactured: for more depends upon the Manufacturer than the Dyer, in this case. For these things the Manufacturer is referred to the article headed "Obstacles to Dyeing in the Piece."

There is always more or less demand for Black—that and Indigo Blue being Standard Colors; the other Colors, individually, disappear, at times, from the market, depending upon fashions for their temporary existence; therefore, they are designated in Cloth Dyeing, as Fancy Colors; whilst Black and Blue are the fixed or Standard Colors.

Black, then, being the principal Color called for on this kind of fabric, a little more room will be devoted to it, than most of the others, and several methods of Dyeing it will be put down, so as to afford the Dyer a chance of selecting such as may suit best to meet circumstances under which he may be placed, at different times, and at different establishments.

There are various methods of Dyeing this Color, and quite a number of materials may be employed to *body up* the Cotton part of the fabric.

Some of these different plans and substances we will now proceed to lay down; and it will be for the Dyer to select such as appear to him to answer his purpose best—different circumstances requiring a different mode of procedure, in all cases.

FIRST METHOD.

Employing Reels or Whinches only.

First Dyeing.

Logwood chips, 100 lbs.
Fustic " 12½ "
Quercitron Bark, 12½ lbs.

BAG these materials, and boil them two and a half hours; then take out the bags, and add

Sulphate of Copper, 10 lbs.

When this is dissolved, cool down the Kettle, and enter the Cloths in two drafts or strings; run about five ends, before bringing up to a boil; then boil three-fourths or a full hour: take out, air and drain well. Preserve the above liquor for further use.

Tannin Process.

Shumac, 25 lbs.
Logwood, 25 lbs.
Sal Soda, 2½ lbs.

Boil these together for an hour in a convenient vessel, and when settled turn over the clear liquor into the second Kettle, and fill up with cold water, so as to have the Tannin bath at about one hundred and twenty degrees, Fahrenheit. Enter the goods in this: give them five Ends, and lay them down in the liquor for the night. This Kettle may run three or four days in winter, and two or three in summer, without emptying.

After taking the goods out in the morning, drain them well, and make up a fresh bath, as follows, with cold water in summer, and lukewarm in winter.

Mordant Process.

Pro-sulphate of Iron, 8 lbs.
Prolignate of Iron, 8 quarts.

Enter the goods in this, and run three ends; then lay down in the liquor for an hour, or upwards. Take out, drain, and let them rest awhile before washing off.

This Kettle may be run for a week, without emptying; always letting it settle, and running off the sediments at the bottom, before replenishing it for another day's work.

This method of Dyeing leaves the Cloth very clean, and easy to wash off; the Color of the Cotton is also full as fast, as by any other plan.

In using the Shumac and other ground Dyestuffs, if there be no convenience for boiling them up in a separate vessel—in this case, they can all be thrown loose into the Shumac-kettle, and the Cloth run and left in as described, when the clear liquor only is used: but it is always the best to have clear liquors, as it prevents a great deal of unnecessary dirt, and the liability of the Cloths being uneven in Color, by lying upon the ground Dyestuffs.

The above course appears to be—what it really is—the opposite of a natural plan; as by taking the *Dyeing Process* FIRST, we commence where common sense indicates we ought to *terminate* the operations: nevertheless, this plan produces excellent Colors, and there is no objection to following it. It has been introduced merely as a reverse method to the more natural and direct one, of beginning with the Shumac first, in order to avoid the trouble of washing off between any of the operations.

A SECOND DYEING IN THE SAME LIQUOR.

TO THE remaining liquor of the first Dyeing, add the following articles in the

Dyeing Process.

Logwood chips, 75 lbs.
Fustic chips, 10 lbs.
Quercitron bark, 10 lbs.

Treat these Dyestuffs as for the first Dyeing; then dissolve in the liquor

Sulphate of Copper, 6 lbs.

Enter the Pieces, run, and boil an hour. Take out, air and drain well. Strengthen your Shumac-tub or Kettle, with

Shumac, 25 lbs.
Logwood, 15 lbs.
Sal-soda, 2 lbs.

Enter the goods into this, and leave them in all night. After taking out and draining well in the morning, run off a little of the bottom of the Iron liquor Kettle, to carry out the sediments: then strengthen it with

Proto-sulphate of Iron, 4 lbs.
Pyrolignate of Iron, 8 pints.

Enter the goods into this, as described in the first Dyeing; letting them remain in the liquor an hour or two, and drain well before washing off.

REVERSE METHOD OF THE PRECEDING.

Tannin Process.

Shumac. 25 lbs.
Logwood (ground), 20 lbs.
Fustic " 5 lbs.

Treat these Dyestuffs, and handle the Cloths as described in the Shumacking of the preceding method.

Mordant Process.

Sulphate of Iron, 8 lbs.
Pyrolignate of Iron, 12 pints.

After running the goods three or four ends, and letting them lie in the liquor an hour or two, wash off well, and after a thorough draining, Dye up as follows:

Dyeing Process.

Logwood chips, 75 lbs.
Fustic, " 8 lbs.
Quercitron bark, 8 lbs.

After boiling these up as usual, and taking out the bags, add

Bisulphate of Copper, 8 lbs.

Enter the goods at a boil-heat, and run three-fourths of an hour: then bring up the heat, and give a very gentle boil for one-fourth of an hour, and take out. The Tannin and Mordant Processes are used cold, or, at most, not more than one hundred and twenty degrees Fahrenheit.

The several liquors can be preserved for further use, as mentioned in the preceding examples; and for succeeding Dyeings, the quantities of the materials will have to be reduced or augmented, according to the depth of Color wanted. In all these cases the Dyer has got to exercise his own judgment.

ANOTHER METHOD.

The Dyeing Process done by the Machine.

PREPARE the liquor of the Machine for the commencement, as follows:

Hematine, 100 lbs.
Shumac, 25 lbs.
Soda Ash, 25 lbs.
Sulphate of Copper, 12½ lbs.

Boil out the Shumac in a convenient vessel, and pour the clear liquor (without the sediments,) into the Machine; then dissolve the Hematine and Sulphate of Copper in the same, the Machine being filled with water sufficient to bring it to a working height: after this, add the Soda Ash, very carefully, by little at a time—having the liquor at about one hundred and seventy-five degrees, Fahrenheit—raking up the Kettle or Machine, to aid the solution of the several materials. When everything is fairly dissolved—which is known by the foaming of the liquor ceasing—the Dyeing liquor is ready for use, and should appear Red-purple.

Dyeing Process.

Run the Cloths through the above liquor from Roll to Roll three times, or six Ends: then, after they have drained sufficiently on the Roll, take them off, air them in a neat and straight manner, in front of the next Kettle, which has a Reel or Whinch upon it, as in the common or regular way of Cloth Dyeing.

To make the next liquor, or the Mordant Bath, for twenty-four Pieces, or a full day's work for the Machine, and which may as well be run through at one time (provided the Kettle, Tub, or vessel be large enough,) use the following:

Mordant Process.

Shumac, 25 lbs.
Pyrolignate of Iron, 12 pints.
Protosulphate of Iron, 6 lbs.
Bisulphate of Copper, 2 lbs.

Boil up the Shumac, and take the clear liquor only into the Kettle, in which dissolve the other ingredients, and run the Cloths in it at a boil-heat for one hour; take out, air, and drain well. Then return them, six Pieces at a time, giving them four Ends through the liquor of the Machine, after it has been strengthened with the following articles:

Hematine, 9 lbs.
Soda Ash, 6 lbs.
Sulphate of Copper, 6 lbs.

The Color is now finished, on the first six Pieces; and in Dyeing up the remainder, the liquor must be strengthened with the same quantity as the above, for every succeeding Dyeing of six Pieces.

For the next and succeeding day's Dyeings, the Iron liquor vessel must be strengthened, for every twenty-four Pieces, with

Shumac, 12 lbs.
Pyrolignate of Iron, 4 quarts.
Sulphate of Iron, 4 lbs.
Sulphate of Copper, 2 lbs.

The strength of the Dyeing liquor in the Machine, must also be kept up, with

Hematine, 12 lbs.
Shumac, 6 lbs.
Soda Ash, 6 lbs.
Sulphate of Copper, 6 lbs.

for every six Pieces to be Dyed.

Proceed with the Dyeing operations of each day, as has been described above. This plan is essentially the same as what is universally followed through the country; for the simple reason, that *they don't know any other.*

ANOTHER METHOD.

At Two Liquors—Mordant and Dyeing.

Shumac, 12 lbs.
Fustic, 6 lbs.
Sulphate of Copper, 6 lbs.
Pyrolignate of Iron, 1½ pints.

BOIL the Shumac and Fustic in a vessel, as before-mentioned, and take the clear liquor into your Kettle, and dissolve the other ingredients in it. Run the Cloths in this over the Reel for an hour and a quarter, at the temperature of one hundred and seventy-five degrees, Fahrenheit. Take out, air, and drain well: then enter the goods into the Machine, to the Dyeing liquor of which add as follows, in the

Dyeing Process.

Hematine, 12 lbs.
Fustic (strength of,) 6 lbs.
Sulphate of Copper, 3 lbs.
Soda Ash, 6 lbs.

Run the goods from Roll to Roll in this liquor, six Ends at a boil-heat, boiling at the last End if necessary.

You will observe that in all cases of Dyeing Black by the Machine, the Color of the liquor should appear of a Red-purple hue; if it looks blue and thin, or inclines to Black, give it Soda Ash until it assumes that Color, without reference to the quantity of Soda it may require.

If the liquor looks too much on a Crimson, give a little Sulphate of Copper, till you get the Reddish-purple hue.

A SUPERIOR METHOD TO ALL OTHERS FOR THESE KINDS OF GOODS, AND RUN OFF IN ONE LIQUOR, BY MACHINE.

Aggregate Process.

For making up the first or Standard liquor, for a Box or Machine of the size described in the article "Dyehouse," use the following materials:

Quercitrine, 15 lbs.
Hematine, 75 lbs.
Bisulphate of Copper, 15 lbs.
Soda Ash, 15 lbs.

Dissolve all these together excepting the Soda Ash, which must be added very gradually to the other after they are in solution; the heat having been reduced before the Soda Ash is given, on account of the great agitation caused by the action of the Alkali on the Sulphate of Copper.

The liquor, if right, should now appear of a rich, deep, Red-plum color, or—if we may so speak—of the color of the ripe wild Grape. If inclining to be too Blue, or to a Black or Olive shade, give more Alkali, until the desired hue is brought up; if it bears too much on the Crimson shade, give more Sulphate of Copper.

If the liquor has the appearance above-described, it is ready to receive the Cloth, which enter at about two hundred degrees, Fahrenheit, and run four or six Ends, from Roll to Roll—boiling at the last two Ends. Air well, and after resting an hour or two, see if the Color has come up a good, clear, bright Jet Black.

If it assumes and maintains too much of an Olive cast, it indicates too much Quercitrine in proportion to the Hematine, which is remedied by strengthening the liquor with about six pounds of Hematine, and running two Ends on the Rolls. This is the only defect to be anticipated from this method of Dyeing, and any Dyer certainly ought to know enough to correct any variation from the shade he has to Color to, without requiring every minutiæ to be noted down in the Formula of a Color.

Every succeeding Dyeing of six Pieces will require the liquor strengthening with about the following ingredients and quantities:

Hematine, 12 lbs.
Quercitrine, 2½ lbs.
Sulphate of Copper, 4 lbs.
Soda Ash, 4 lbs. (more or less.)

The liquor, before Dyeing, always to be a Grape color. The Pieces to be entered below the boil: run six Ends, and the last two at a gentle boil. A little variation may be given to this operation of Dyeing, by running three or four Ends, at a low heat; then taking out and airing well, and again running the remainder of the Ends, at a gentle boil; and you may either give it all the materials at once, or take two-thirds of them in the first Dip and the other third in the last, but this is immaterial.

In all cases, for this mode of Dyeing, the Pieces are to be well Carded, Scoured and dry-Cropped, and taken dry into the Dyeing liquor; and, if justice has been done them in all these respects, you will obtain the richest and best. Black ever Dyed on Cotton and Wool goods.

Quite a number more plans could be given for Dyeing this Color, but here are a sufficiency to answer all practical purposes, and to meet almost all emergencies and circumstances: any of which will produce first rate Colors from the hands of a skillful and intelligent Dyer, and no other ought to be employed in the business.

I have been led to enlarge upon the different methods of Dyeing Black. because it is the most general Color, and a Standard in the market.

If in any case of Dyeing Black, or in fact, of any other Color, the Cotton should not be quite deep enough, or up to the Wool, the remedy is to give them the Tannin or Mordant Processes, cold; which, in all instances, will never fail bringing them up. The *quantity* of the ingredients to be given in such cases, depends upon the difference of shade between the Cotton and Wool parts of the fabric; the Dyer's experience will suggest to him how to proceed in each instance.

PLUM OR CORBEAU.

Dyeing Process—by reels.

Hypernic chips, 48 lbs.
Logwood chips, 32 lbs.
Fustic chips, 8 lbs.
Sulphate of Copper, 6 to 8 lbs.

MIX and bag the Dye-woods, and boil an hour and a half; draw the bags, and dissolve the Sulphate of Copper: enter the Cloth at a boil-heat, and run an hour—the last fourth of which time, at a gentle boil. Take out, air, and drain well.

Tannin Process.

Shumac, 20 lbs.
Logwood 10 lbs.
Hypernic, 10 lbs.

Boil these drugs up in a separate vessel (if convenient,) and take the clear liquor into the Tannin-kettle: run the goods five Ends, at one hundred and forty degrees, and let them steep all night.

Mordant Process.

Pyrolignate of Iron, 8 pints.
Protosulphate of Iron, 4 lbs.
Bisulphate of Copper, 2 lbs.

After draining the Cloths well, turn them three or four Ends through this solution, lukewarm in winter—in summer at the common temperature of the water, and leave them in an hour and a half.

This is a good self-Color for these kinds of fabrics, and is a good old-fashioned shade, but no worse for that—although at the present day very seldom called for.

We will give the reverse method of Dyeing it, which is a little the best, if you are not afraid of the trouble of washing.

REVERSE METHOD—BY REELS.

Tannin Process.

Shumac, 25 lbs.
Logwood, 12½ lbs.

Take the clear liquor of these articles, and run the Cloth five Ends, at one hundred and fifty degrees of heat, and steep all night: n th e morning take out, and drain well from the Tannin liquor.

Mordant Process.

Pyrolignate of Iron, 8 pints.
Protosulphate of Iron, 8 lbs.

Run five Ends in this solution, at the common heat of the water in summer and lukewarm in winter (ninety-eight or one hundred degrees.) Let them remain in the liquor two hours: take out, drain and then wash off well, and afterwards drain them completely from the water, before entering them into the

Dyeing Process.

Hypernic wood, 48 lbs.
Logwood, 32 lbs.
Fustic, 8 lbs.
Sulphate of Copper, 8 lbs.

Boil up the Dye-woods one and a half hours; take out the bags, and dissolve the Sulphate; Reel the goods through this for one hour at a boil-heat (say two hundred degrees,) then bring up to a gentle, simmering boil for one-fourth of an hour, and take out, air well, and drain. This method gives a little bloomier and brighter hue than the preceding; but either method will answer. You may vary the shades of this Color, by giving more or less Logwood or Hypernic, or both.

DYEING OFF IN ONE LIQUOR—BY MACHINE.

Aggregate Process.

Braziline, 60 lbs.
Hematine, 30 lbs,
Quercitrine, 9 lbs.
Bisulphate of Copper, 10 lbs.

DISSOLVE all these together, then cool down too ne hundred and eighty degrees, and enter the Cloth dry and Cropped; run from Roll to Roll three or four Ends, at this temperature; then take out, and air well.

Examine the Color after cooling, when, if you think it will not come up deep enough for the Pattern, you may have to color on its return into the Machine again, then you must strengthen the Vat by the addition of the following drugs (more or less, according to shade, or your own ideas :)

Braziline, 6 lbs.
Hematine, 4 lbs.
Quercitrine, ½ lb.
Bisulphate of Copper, 5 lbs.

When these are dissolved, re-enter the Cloth at a boil-heat; run three or four Ends, the last End or two at a gentle boil.

For every succeeding Coloring of six Pieces, use the last-named quantities of Dye-drugs, and treat the goods as in the first Dyeing. Any variation of shade you will obtain by regulating the relative quantities of Hematine and Quercitrine. If any time the Cotton should be lighter than the Wool, take the Tannin and Mordant Processes, with small quantities of Shumac and Iron.

OLIVE.

We now come upon a class of Colors, the method of Dyeing which, upon Cotton and Wool goods in the Cloth, has never been practised by any of the Dyers where these fabrics are made: I am, therefore, going to open, as regards them, a mysterious and unknown series of operations and methods of procedure, which in a simple and easy manner obtain Colors, that they have at present no knowledge of any means of producing, nor any idea that they *ever* could be produced on this compound kind of fabric.

Commencing with Olive, I am not aware that a single Color described through all the following pages of this book has ever been Dyed on Cotton and Wool goods in the Piece, by any other Dyer in the country; though it is possible some may have been done without my knowledge, but it is doubtful.

Therefore, in what follows, you will find yourself upon new ground in regard to one particular branch of Dyeing, undescribed by any writer, and untrodden by any Dyer, save the one who lays the description before you, without the slightest misgiving but you will find everything laid down in such a manner, as that "he who runs may read," and that everything is in accordance with the most correct principles of Dyeing, and in unison with Chymical facts.

The Recipes are the correct descriptions of individual experience, largely practised upon by their inventor, and can be recommended by him as truthful and effectual methods of producing all the Colors to which they relate.

FIRST METHOD.

TO BE WORKED BY THE REELS, ONLY.

Tannin Process.

Shumac, 18 lbs.
Cutch, 6 lbs.

Enter the Cloth, and turn five Ends in these at the temperature of one hundred and thirty degrees, Fahrenheit, and leave in all night.

Mordant Process.

Pyrolignate of Iron, 8 pints.
Proto-sulphate of Iron, 6 lbs.

After draining the Cloth from the Shumac liquor, run them three Ends in the Mordant Kettle, at one hundred and twenty degrees, Fahrenheit, in winter, and cold in summer: let them remain an hour or two; then drain and wash off.

Dyeing Process.

Logwood, 8 lbs.
Fustic, 50 lbs.
Hypernic wood, 16 lbs.
Sulphate of Copper, 4 or 6 lbs.

Boil up the Dye-woods and throw out the bags, before giving the Sulphate of Copper: then, having the Pieces well drained, enter them at a boil-heat, run them for an hour, and finish by boiling a quarter of an hour.

All these liquors can be preserved for other Dyeings, and can be used for two or three days, without commencing with fresh baths.

We will give the reverse of this method, in which no washing is required between the operations.

REVERSE OF THE FIRST METHOD.

Dyeing Process—by the Reels.

BROWN OLIVE.

Fustic, 60 lbs.
Hypernic wood, 20 lbs.
Logwood, 10 lbs.
Sulphate of Copper, 6 lbs.

Mix the Dye-woods together, and bag and boil them two hours: withdraw them and add the Sulphate of Copper, then enter the goods at a boil-heat and run an hour and a quarter—the last half of it at a gentle boil-heat. Take out, air well, and drain.

Tannin Process.

Shumac, 20 lbs.
Quercitrine, 5 lbs.

Enter the goods and run them five Ends, at one hundred and twenty degrees in winter, and at the regular temperature of the water, in summer. Lay them down all night: in the morning take out, and drain well.

Mordant Process.

Pyrolignate of Iron, 8 pints.
Proto-sulphate of Iron, 4 lbs.

Give the Pieces three or five Ends through this, at a lukewarm heat in winter and cold in summer, and let them remain in the Kettle an hour or two before taking out.

STANDARD OR TRUE OLIVE.

Dyeing Process—with Reels.

Fustic, 60 lbs.
Logwood, 20 lbs.
Hypernic, 10 lbs.
Sulphate of Copper, 6 lbs.

Mix and bag these Dye-stuffs, and boil a couple of hours. Withdraw the bags, before adding the Sulphate of Copper.

Enter the goods at one hundred and eighty or one hundred and ninety degrees: run about an hour, and then boil a quarter of an hour. Take out, air and drain well.

Tannin Process.

Shumac, 25 lbs.

Turn the Cloths through the above for five Ends, at one hundred and twenty degrees in winter, and at the common temperature in summer. Let them remain in the liquor all night.

Mordant Process.

Pyrolignate of Iron, 8 pints.
Proto-sulphate of Iron, 4 lbs.

Reel or Whinch them through this for four or five Ends, and leave them well stopped down under the liquor for an hour or two.

GREEN OLIVE.

Dyeing Process—by Reels.

Fustic, 45 lbs.
Cutch, 8 lbs.
Logwood, 30 lbs.
Sulphate of Copper, 6 lbs.

Boil the Dye-stuffs out for one hour and a half, and take out the bags before adding the Sulphate of Copper.

Enter the goods in the usual manner, and give them about three-quarters of an hour's run over the Winch, and then a gentle boil for about half an hour: air and drain.

Tannin Process,

Shumac, 15 lbs.
Quercitrine, 5 lbs.

Enter the Cloths into this at the natural temperature of the water. Reel them five Ends, and lay down over night.

Mordant Process.

Pyrolignate of Iron, 6 pints.
Proto-sulphate of Iron, 3 lbs.

After draining them well from the Shumac liquor, enter into the Mordant liquor at the natural temperature of the water: turn a few Ends, and then lay them down an hour.

Dyeing Process—by Machine.

Quercitrine, 60 lbs.
Hematine, 20 lbs.
Braziline, 10 lbs.
Bisulphate of Copper, 10 to 15 lbs.

Dissolve all these together in the Machine by boiling, then cool down to one hundred and eighty degrees, Fahrenheit. Enter the goods, (dry,) having them previously Cropped: give three or four Ends, from Roll to Roll: take out, and give a good airing; then return into the Machine, and give from three to four Ends more, when they are finished.

Remarks.—The above quantities of Dye-stuffs are for the commencement of a fresh bath; the following Dyeings will require the Machine-bath to be strengthened with these quantities of Drugs for every six Pieces, or one hundred and fifty yards.

Quercitrine, 9 lbs.
Hematine, 3 lbs.
Braziline, 1½ to 2 lbs.
Bisulphate of Copper, 4 lbs.

Proceed in the second and subsequent Dyeings as stated for the first. If the particular shade you have to Color to should require any Soda Ash, give it before entering for the return Dip, at the rate of ten pounds for the first Dyeing, and three to five for the second and following Dyeings of six pieces each: but dispense with the Alkali, if the shade will allow of it.

If the Cotton should ever happen to vary in depth of Color from the Wool part of the fabric, treat it with the Tannin and Mordant Processes lightly, and it will remedy the defect.

You will obtain the different varieties of Olive, by a judicious management of the quantities of the different Drugs.

BROWN.

THIS, in all its varieties, is a substantial and handsome Color for this description of Cloth, and whether Printed upon or going as a plain Color, will always be more or less in demand as long as this particular fabric shall occupy a place among marketable articles. I am pretty certain that no one has succeeded in producing this Color on Cotton and Wool goods in Piece Dyeing, (though several have unsuccessfully attempted it,) up to the present time, with the exception of the writer of the following Recipes for producing the different shades of this Color—every one of which may be relied upon as most effectual in producing the effects attributed to them.

YELLOW BROWN.

Dyeing Process—by Reel.

Fustic, 50 lbs.
Hypernic, 25 lbs.
Cutch, 12½ lbs.
Sulphate of Copper, 6 lbs.

Mix and bag the Dye-woods, boil an hour and a half; draw the bags and dissolve the Sulphate of Copper; then enter the goods at one hundred and eighty degrees; run three-fourths of an hour and bring up to a boil, which continue a quarter of an hour: take out, air and drain well. Use one-fifth more of every kind of the above Drugs for the first Kettlefull, and preserve the liquor for continual use, always giving the above quantity of articles to every eight Pieces after the first Dyeing.

Tannin Process.

Shumac, 25 lbs.

Take the clear liquor of the Shumac, run five Ends at one hundred and twenty degrees in winter, and at the common temperature in summer; leave them in all night. In the morning, after draining them well, give them four or five Ends, and let them remain in the liquor an hour, the solution being cold.

Mordant Process.

Pyrolignate of Iron, 6 pints.
Proto-sulphate of Iron, 4 lbs.

Should your Cotton come up too dark, any time, use one-fourth less Shumac. This is a very good shade for Printing, and leaves the Cloth very soft and glossy.

REVERSE OF THE FIRST METHOD—BY REEL.

YELLOW BROWN.

Tannin Process.

Shumac, 25 lbs.
Cutch, 12½ lbs.

Run the Cloths five Ends, and lay them down all night; heat, one hundred and forty degrees.

Mordant Process.

Pyrolignate of Iron, 8 pints.
Protosulphate of Iron, 4 lbs.

After draining well from the Shumac liquor, run the goods four or five Ends in this bath at the common temperature of summer, and leave them in an hour or two; then take out, drain and wash well.

Dyeing Process.

Hypernic, 25 lbs.
Fustic, 60 lbs.
Sulphate of Copper, 6 lbs.

Mix, bag, and boil these Dye-woods two hours; withdraw the bags, and dissolve the Sulphate of Copper; enter the goods at a boil-heat (say two hundred degrees, Fahrenheit;) run over the Whinch for about three-fourths of an hour; bring up to a gentle boil for ten or fifteen minutes; then take out and cool well before folding up the Cloths for washing.

This method of Dyeing is a little more trouble than the preceding, on account of the washing from the Mordant, but the color of the Cotton and the Wool are more alike.

In both these methods you must preserve the Dyeing liquors for constant use, running a little off every morning, with a view of carrying off the sediment which has accumulated by the previous day's Dyeing. You may run the Shumac liquor two or three days, but the Iron liquor is best, fresh every day.

RED BROWN.

Tannin Process

Shumac, 25 lbs.
Cutch, 12½ lbs.

TREAT the Cloths in all respects like the preceding; at one hundred and thirty degrees.

Mordant Process.

Pyrolignate of Iron, 8 pints.
Protosulphate of Iron, 4 lbs.

Treat cold, and in all respects as the foregoing. Wash off well.

Dyeing Process.

Fustic, 40 lbs.
Hypernic wood, 40 lbs.
Sulphate of Copper, 8 lbs.

Mix, bag and boil these one hour and a half; take out the bags and dissolve the Sulphate, then having drained your Cloth well from the washing, enter the goods at a boil-heat, run an hour, and take out.

You may save some labor and time by reversing this method, but the color on the Cotton and the Wool will be more similar in shade by this plan than by beginning with the Dyeing process first; because the Brown color coming last, covers or falls upon the Black hue given by the Shumac and Iron, and hides the last from view; whereas the Shumac and Iron, coming over the Brown on the Cotton, gives an Olive shade to it, very distinguishable when the goods are finished, imparting a muddied appearance to the Color, which ought to be avoided.

However, you can take either plan by a reversion of the above, taking the Dyeing process first, the Tannin next, and terminating with the Mordant process.

DARK BROWN.

Dyeing Process—by Reels.

Hypernic wood, 40 lbs.
Fustic, 32 lbs.
Logwood, 8 lbs.
Sulphate of Copper, 8 lbs.

Mix, bag, and boil the Dye-woods an hour and a half; then after taking out the bags, dissolve the Sulphate of Copper, and enter the goods at one hundred and eighty degrees, Fahrenheit; having Reeled five Ends, bring up the heat, and boil until the Cloths have been in the Kettle, in full time, one hour: take out, air and drain.

Tannin Process.

Shumac, 25 lbs.

Treat the Cloths in this liquor as usual. Temperature, one hundred and twenty degrees.

Mordant Process.

Pyrolignate of Iron, 8 pints.
Protosulphate of Iron, 4 lbs.

Drain well from the Shumac liquor, and run through the Iron Mordant four or five Ends, at one hundred and twenty degrees in winter, and cold in summer: let them remain in the Mordant one hour.

As this is a dark, sombre Color, it is immaterial whether the Shumac and Iron be used first or last in Dyeing it, although the Color looks a little livelier, by reversing these processes. You can take either plan at your own discretion, all you have to do in this case is to begin with the Tannin process, then the Mordant, and wash off: concluding with the Dyeing process. The Drugs in each process being the same as above, in formula.

DYEING OFF IN ONE LIQUOR—BY MACHINE.

Make up the Standard liquor for the first Dyeing as follows :

Quercitrine, 50 lbs.
Braziline, 25 lbs.
Cutch, 12½ lbs.
Bisulphate of Copper, 12½ lbs.

Dissolve all thes Drugs thoroughly; then cool down the liquor to one hundred and eighty degrees: enter the Cloths well Cropped and in a dry state, and run them at this heat from Roll to Roll for three or four Ends: take out and air well. If not likely to be deep enough in Color, give them the following quantities of Drugs before re-entering them into the Machine.

Quercitrine, 2 lbs.
Braziline, 1 lb.
Cutch, ½ lb.
Bisulphate of Copper, 2½ lbs.

After these are dissolved, re-enter the goods at a boil-heat, and boil gently the last two Ends; giving them in all six Ends for the two runs. Supposing the liquor now of a sufficient Standard strength, add to it the following Drugs for every subsequent Dyeing of six Pieces each time.

Quercitrine, 8 lbs.
Braziline, 4 lbs.
Cutch, 2 lbs.
Bisulphate of Copper, 4 or 6 lbs.

When these are dissolved enter the Cloth and proceed as in the first Dyeing. In any case of the Cotton being too light for the Wool, a passage through the Tannin and Mordant processes, as usual, with very little Shumac and Iron, will suffice for all difficulties.

All the shades of Brown will be obtained by the Machine, equally as well as by the Kettle and Reel; by proportioning the relative quantities of the materials according to the pattern you have to Dye to. The principle is laid down here that will answer for all shades, and the skill of the Dyer will be called into requisition to produce the variations.

If the goods have been well managed in the Carding, so as to leave the face of the Piece, when finished, perfectly smooth and free from lumps of Cotton, and have been well raised and Cropped, and entered dry into the liquor of the Machine, then there is a certainty of both the Cotton and the Wool being colored; but by taking them into the Machine both uncropped and wet, with the Cotton all rolled up into small, hard knots, by defective Carding, then the chance is that all these defects in the manufacture will show themselves upon the Cotton part of the fabric, and the fault is in the manufacturer, and not in the Dyer, or in the mode of Dyeing. This will be the case, not only in this, but also in all other colors, whether Dyed with the Machine or by the Reels; but the Shumacking and Ironing of the goods, either before or after the Dyeing process, covers up effectually every defect.

GREEN.

THIS color, excepting only its very darkest shades, is but little called for as a self-color, but the medium and light shades are well adapted for Printing purposes.

It is, therefore, necessary to give a few examples of the means of producing some of its shades.

These colors require considerable nicety of management, and a strict guard kept upon the Fustic and the Soda employed, as in the case of the Fustic, the Dyer is very apt to be mistaken in its mode of operation, and to underrate its real powers; he should, therefore, always take care to be on the under side with it, as it has a continual tendency to prevail over other Dyestuffs, and in this color, especially, it looks very bad when in excess: too long boiling is apt to make it pass to a dun shade, and then the whole color appears flat and dingy. The Soda also must be well looked after, judging more by the appearance of the liquor than anything else, when the proper quantity has been given, as too little leaves the color flat and lusterless, and too much has the effect of stripping the Cotton.

All the shades of this color are regulated by the quantities of Blue and Yellow in its composition, so if a Blue shade is wanted, more Logwood must be given, and if a Yellower one, more Fustic is required: if darker, more of both; if lighter, less of both: but these matters all belong to experience; and no Dyer of long standing in the business needs any of these minor observations for his instruction.

DARK GREEN—BY REELS.

Tannin Process.

Shumac, 20 lbs.
Logwood, 10 lbs.

Run the Cloth five Ends in this liquor at a lukewarm heat, and lay them in for the night.

Mordant Process.

Pyrolignate of Iron, 4 pints.
Sulphate of Copper, 4 lbs.

After the goods have drained well, turn them through this for four or five Ends; then take out after lying in the liquor for an hour: drain and wash off, and allow them to drain off well.

Dyeing Process.

Fustic chips, 32 lbs.*
Logwood chips, 24 lbs.
Sulphate of Copper, 6 lbs.

Boil up the Dye-woods an hour and a half, and then throw out the bags: then dissolve the Sulphate, and enter the goods at one hundred and eighty degrees; run them for about three-fourths of an hour: take out, air, and drain well: then add very gradually to the Dyeing liquor

Soda Ash, 5 or 6 lbs.

Bring the liquor up to the boil-heat, or a gentle spring: re-enter the Pieces, and run half an hour—the last ten minutes at a quiet boil. The liquor, after the addition of the Soda, should look a bright, lively green: too much Soda strips the Cotton. If you wish to avoid the trouble of washing between the operations, reverse this method, by Dyeing first and then Shumacking and Ironing afterwards; only omitting the Sulphate of Copper in the Mordant.

ANOTHER SHADE—BY REELS.

Tannin Process.

Quercitron bark, 16 lbs.
Logwood, 24 lbs.
Shumac, 12½ lbs.

Boil these articles well in a convenient vessel; let them settle, and add the clear liquor to the Tannin bath—the water being cold in summer, and in winter merely tepid.

Run four or five Ends, and leave the Cloth in all night.

Mordant Process.

Bisulphate of Copper, 8 lbs.

Dissolve the Sulphate in a small quantity of boiling water in a wooden vessel, and turn it over into the Mordant bath of cold water, and run the Cloths five Ends, lay down for an hour, then take out and let them drain well on the Whinch or Reel, and without washing transfer them, after folding, to the

Dyeing Process.

Fustic, 24 lbs.
Logwood, 16 lbs.
Sulphate of Copper, 4 to 6 lbs.

Boil the Dye-woods one hour and a half; heave out the bags; dissolve the Sulphate; enter the Cloths; run half an hour, at one hundred and eighty degrees: take out and air them. Dissolve in the liquor gradually

Soda Ash, 4 to 6 lbs.

Bring the liquor up to a boil-heat; re-enter the Pieces and run half an hour, the last five or ten minutes at a gentle boil. Preserve all these liquors for further Dyeings, in which case you may diminish the ingredients a little for subsequent colorings.

DYEING OFF IN ONE LIQUOR—BY MACHINE.

Aggregate Process.

Prepare the standard liquor of the Machine as follows:

Quercitrine, 25 lbs.
Hematine, 25 lbs.
Bisulphate of Copper, 10 lbs.

Dissolve all these together in the Machine bath, and reduce the temperature to one hundred and eighty degrees: run the Cloths three or four Ends on the Rolls; take out and air well: in the meantime strengthen the bath (if you think the depth of the desired color requires it) with

Quercitrine, 8 lbs.
Hematine, 8 lbs.
Bisulphate of Copper, 2½ to 5 lbs.

When these are dissolved, add gradually to the liquor at two hundred degrees,

Soda Ash, 10 to 12½ lbs.

When all the drugs are fairly in solution, and the foaming of the liquor has ceased, re-enter the Cloth, and run three or four Ends at a very gentle boil: six Ends at the two dips, is generally sufficient to color them properly

We must repeat, that the goods are presumed to be well Carded, Cropped and dry, when they are entered into the liquor the first time, and then there will be no trouble about the Dyeing; but if, through any oversight in managing the liquor, there should at any time be a deficiency in the Cotton, Shumac and Iron them slightly; but this will rarely be the case, and will only occur for want of experience and tact in the management of the Dyeing, as the articles and the method used are quite sufficient at all times to color them effectually. The only difficulty in this color will be owing to the want of practice in the Dyer, which will soon be overcome by a few trials. Everything depends upon the Dyer's ingenuity and aptitude in producing the various shades of this color: the principle is here, and it is for him to work the materials according to the particular pattern required, which skill and previous experience alone can effect.

For every succeeding Dyeing of six Pieces, use

Quercitrine, 6 lbs.
Hematine, 6 lbs.
Bisulphate of Copper, 6 lbs.

Run in this solution at one hundred and eighty degrees, three Ends: take out and air; then add to the liquor gradually,

Soda Ash, 6 lbs.

Re-enter at a boil-heat, run three Ends, with a gentle boil the last End.

You will regulate the depth of the color and its particular shade, by adding or diminishing the quantity of the Quercitrine and Hematine, and by varying their relative proportions.

PURPLE.

TO BE WORKED BY THE REELS ONLY.

Tannin Process.

Shumac, 20 lbs.
Logwood (ground), 15 lbs.

TAKE the clear liquor of these; run the goods five Ends at one hundred and twenty degrees, and leave them in over night: after draining well, in the morning run them for an hour in the

Mordant Process.

Pyrolignate of Iron, 8 pints.
Protosulphate of Iron, 4 lbs.

After coming from this bath, which you will use cold, let them be well washed off and drained.

Dyeing Process.

Hypernic, 50 lbs.
Logwood chips, 25 lbs.
Sulphate of Copper, 6 or 8 lbs.

Mix, bag and boil the Dye-woods for one hour and a half, then withdraw the bags and dissolve the Sulphate: enter the Cloth at one hundred and eighty degrees, and whilst Reeling the goods, gradually bring up the heat, so that by the time they have been in the liquor one hour, it may be, at a boil, which continue gently for two Ends: take out and air well before washing. Save the Dyeing liquor for further use.

This color is well adapted for Printing with figures of a Gold or Green: it will also answer for a self-color for coats, &c.; and on fine Cashmeretts, it is an elegant shade for Ladies' cloaks, mantillas, &c.

This method may be reversed, by Shumacking and Ironing last.

DYEING OFF IN ONE LIQUOR—BY MACHINE.

Aggregate Process.

Prepare the standard liquor of the bath, as follows:

Braziline, 40 lbs.
Hematine, 18 lbs.
Bisulphate of Copper, 10 lbs.

Dissolve all these together; reduce the temperature to one hundred and eighty degrees; run the Cloth (Cropped and dry) into this liquor; give it three or four Ends from Roll to Roll; take out and air well. In the meantime, strengthen the bath with

Braziline, 7 lbs.
Hematine, 5 lbs.
Bisulphate of Copper, 5 lbs.

Dissolve all these together, and reduce the heat to two hundred degrees, Fahrenheit; re-enter the Pieces, and run three or four Ends, the last End or two at a gentle boil.

For every succeeding Dyeing of six Pieces, use

Braziline, 8 lbs.
Hematine, 4 lbs.
Bisulphate of Copper, 6 lbs.

Treat the Dyestuffs and the Cloths in all respects as for the first Dyeing: only if you think proper you can strengthen the bath in the return dip, by a small quantity of the above drugs.

You will get the various tints of this color, by varying the quantity and relative proportions of the different ingredients. If you require a deeper shade, use more of all; if Lighter, use less: if a Redder hue, use more Braziline or less Hematine; and if it be wanted Bluer, use more Hematine or less Braziline, as the case requires.

LAVENDER.

Although this color belongs to the Minor Shades of Color, and may appear out of its regular place, it is thought advisable to insert it here, as partaking about equally of the hue both of Purple and Blue.

Tannin Process—with Reels.

Logwood, 16 lbs.
Nut-galls (ground,) 4 lbs.

Take the clear strength of these articles, and pour them into the Tannin bath; enter the Cloth at seventy-five degrees, run five Ends, and leave them in all night.

Mordant Process.

Sulphate of Copper, 4 lbs.
Sulphate of Iron, 2 lbs.

After draining well from the Tannin liquor, run the Pieces through this cold solution five Ends, and let them soak an hour or two.

Dyeing Process.

Logwood, 8 lbs.
Hypernic, 8 lbs.
Sulphate of Copper, 2 lbs.

Give the strength of these drugs to the Dyeing bath, and after washing and draining the Cloths from the Mordant, enter them at one hundred and sixty degrees, and run them till finished, which will take about three-quarters of an hour. The Dyer will vary the quantities and relative proportions of the ingredients, as well as the increase of temperature, to accommodate the shade of his pattern. He can also, for some shades of Lavender, omit the washing off out of the Mordant.

BLUE.

A RICH, full Blue is the most desirable color to apply on Cotton and Wool goods for Cloths for men's wear, but at the same time, the most difficult to obtain, both as regards the production of the color, and the trouble and expense attending its Dyeing.

An Indigo Blue can be Dyed on these goods, but the expense of it will probably deter most manufacturers from using it on so low a quality of Cloth.

The next best color in point of beauty and durability, is the Chrome Blue, but on account of the number of operations it has to pass through, it is tedious and difficult to color, and for this reason it will be no favorite with the Dyer. There are more simple methods of Dyeing a Logwood Blue, which, though neither so handsome or permanent as either of the above, will no doubt be preferred, both by the Manufacturer and the Dyer; an example or two of which will be given in detail.

For the information of any one willing to give either of the first-named colors a trial, a few hints, merely, of the outlines of the plan of Dyeing them shall be given, but without any expectation that they will ever be generally practised.

The best and surest method of Dyeing these compound fabrics Indigo Blue, is to run them through a Woad or Jack-Vat, having a machine to hoist and lower into the Vat, precisely the same as for Dyeing Cotton Warps; taking about two hundred yards of Cloth in length, for each separate Dyeing: the Pieces being entered dry and cropped.

Have a great pressure upon the Squeeze Rolls, so as to have as little liquor as possible left in them after every run. About four runs in good Vats will be sufficient to bring up a deep, rich Blue. Air or *ungreen* them thoroughly between the dips. In cases where the Cotton fails in depth of color as compared with the Wool, remedy this by washing off the goods, and then treating them with a strong, cold solution of Logwood, all night, and finish off by running them in a Mordant bath with either six pounds of Sulphate of Copper, or four pounds of Sulphate of Iron. For very deep Blues the latter is preferable.

For a Chrome Blue.—Prepare the Cloths with Bichromate of Potash, &c., as for all Wool goods: wash off well and drain: make up a liquor with eight pounds of Cutch and sixteen of Hematine: run the Cloths five Ends and leave in all night—the solution being cold. Next day run them for an hour through a cold solution of eight pounds of Sulphate of Copper, and after draining them well, finish off in another vessel with Logwood and Hypernic, in quantities according to shade. Enter the Pieces into this liquor at one hundred and eighty degrees, and whilst Reeling, gradually bring up the heat to a boil, at which point if they have been rightly managed, the color will be up.

This is all Reel work for eight Pieces, or two hundred yards.

TO BE WORKED BY THE REELS ONLY.

Tannin Process.

Cutch, 8 lbs.
Hematine, 16 lbs.

Dissolve these, and pour the solution into the Tannin bath, and turn the goods through it five Ends, at about one hudred and five degrees: let them remain in over night: in the morning take out and drain well. Preserve this liquor for the same use.

Mordant Process.

Bisulphate of Copper, 8 lbs.

Turn through this four or five Ends: lay down an hour or so. Temperature one hundred and twenty degrees. Take out, drain, and without washing enter into the

Dyeing Process.

Logwood, 16 lbs.
Hypernic, 8 lbs.
Soda Ash, 1 lb.

Mix, bag and boil these for one hour; take out the bags, and enter the Cloth at one hundred and ninety degrees: run about half or three quarters of an hour at this temperature: take out and air well, then add gradually to the liquor,

Sulphate of Copper, 4 lbs.
Soda Ash, 3 lbs.

Bring the liquor up to two hundred degrees: re-enter the Cloths and run them three-quarters of an hour; the last End or two bring up to a gentle boil. You may substitute Shumac for Cutch in the Tannin process; but in that case, the color will be apt to be a little duller in hue.

DYEING OFF IN ONE LIQUOR—BY MACHINE.

Aggregate Process.

Hematine, 20 lbs,
Braziline, 10 lbs.
Bisulphate of Copper, 8 lbs.
Soda Ash, 8 lbs.

Dissolve the Extracts and the Sulphate together first, then gradually add the Soda, and when all are fairly in solution, and the foaming of the liquor is stayed, reduce the temperature to one hundred and eighty degrees, and enter the Cloth (cropped and dry:) run two or three Ends from Roll to Roll: then take out and air well: in the meantime, if you think the color will not be deep enough, strengthen the liquor with

Hematine, 4 lbs.
Braziline, 2 lbs.
Bisulphate of Copper, 2 lbs.
Soda Ash, 2 lbs.

Dissolve the Extracts and the Sulphate together, and add the Soda after: then bring up the liquor to the boil-heat: re-enter the Pieces; run about three Ends from Roll to Roll, the last one at a gentle boil. The above is the Standard-liquor for this color, which, of course, you will preserve.

For every succeeding Dyeing use the following drugs, and proceed as above :

Hematine, 4 to 6 lbs.
Braziline, 2 to 3 lbs.
Bisulphate of Copper, 3 to 6 lbs.
Soda Ash, 3 to 6 lbs.

If the shade is not wanted so bloomy, use less Braziline: and if at any time the Cotton should be lighter than the Wool, give it a good strong Logwood liquor (cold,) and Mordant (cold,) either with

Bisulphate of Copper, 6 lbs.

or in place of it, give

Sulphate of Iron, 4 lbs.

Let them remain in the cold Logwood liquor all night: and in the Mordant, an hour or two.

You will observe in this place, that in Dyeing by the Machine, not only in Blue, but all other colors, if the color indicates a prospect of coming up to the desired shade, and the Cotton and the Wool are both equal in depth of color, whilst in the first dip, then run them along without taking out, until the Dyeing is fairly accomplished.

It is only to make "assurance doubly sure" that a second dip is recommended, and directions given in regard to it: nevertheless, a second dip is certainly the most positive and sure way; especially for those who have had but little practice in this mode of Dyeing.

The practised Dyer will easily perceive how these Machine-Dyed colors are to be managed: how the quantities and kinds of drugs are to be proportioned and used for every color, in order to produce the best and most economical results. It is not to be expected that any but experienced workmen can take hold of these recipes, and put them through such variations as different circumstances require, in order to obtain the same results as they are calculated to give, when skilfully managed.

Descriptions of other kinds of Blue might be given, but it is almost useless to insert them, as they would very rarely or ever be called for: such as the various shades of Chymic, and Prussiate or Prussian Blue, &c. However, a few hints shall be given in regard to them, merely for the guidance of any who may wish to give them a trial.*

For a Prussian Blue, on the Reels, and with eight Pieces, proceed as follows: steep the Cloths all night in a strong solution of Logwood, with

4 lbs. of ground Nutgalls (previously boiled out.)

In the morning drain well, and run them in a cold bath of

Nitro-muriate of Iron, 8 pints,
Crystalized Muriate of Tin, 2 lbs.,

for one hour: wash off thoroughly, and drain well: then for Dyeing off use

Prussiate of Potash, 1 lb.,

to every ten pounds of Cloth, or about twelve pounds of Prussiate for the eight Pieces; to which add, when dissolved,

Sulphuric Acid, 2 lbs.,

and the strength of

Logwood, 12 lbs.

Begin this Dyeing process at the temperature of the human body, and bring up the heat gradually to one hundred and eighty degrees: then raise and air the Cloths well, and add to the liquor

Sulphuric Acid, 2 lbs.
Crystalized Muriate of Tin, 2 lbs.

Re-enter the Cloth and bring up the heat gradually to a boil, which continue about ten minutes; Reeling and opening carefully the whole time the Cloths are in the Dyeing bath.

If the Cotton should be lighter than the wool at any time, steep all night in strong, cold Logwood liquor, and finish off with

Sulphate of Copper, 6 lbs.
Crystalized Muriate of Tin, 1½ lbs.

cold, and one hour working. The different shades of Chymic or Saxon Blue may be colored on the following plan, and by using

Reels altogether, and taking eight Pieces or two hundred yards as a full quantity for a Kettlefull.

For a full Blue, boil out twelve to sixteen pounds of Logwood chips: add to this liquor four pounds Potash-sulphate of Alumina, two pounds of Super-tartrate of Potash, and as much Extract of Indigo, or Indigo Paste, as the shade you wish to obtain may seem to require: run through this liquor for about three-fourths of an hour: commence at one hundred and eighty degrees, and bring up to two hundred degrees, before taking out to air: whilst airing, give

Crystalized Muriate of Tin, 2 lbs.
Sulphate of Alumina, 2 lbs.
Super-tartrate of Potash, 1 lb.

and if it should require any more Extract of Indigo, give that at the same time, also. Re-enter the Cloths in this, and run about half an hour, the last ten or fifteen minutes at a boil.

Air well and wash off, then drain thoroughly. Now boil up

Logwood, 16 lbs.
Shumac, 8 lbs.
Ground Nutgalls, 4 lbs.

Turn the clear liquor of these into a bath of cold water, or at most not over one hudred degrees temperature: run the Cloth in this five Ends, and lay them down for the night.

In the morning take them out and drain well; then run them through a cold bath of

Nitro-muriate of Iron, 4 pints.
Bi-sulphate of Copper, 4 lbs.

for about one hour: take out, air, drain and wash.

I will observe here, once and for all, that to effect the complete drainage of these Cotton and Wool goods, between one liquor and another in Dyeing all colors, be sure and expose them to the action of the Extractor, if there is one in the establishment—as the liquor of one bath going into that of another, presents the same obstacles in Dyeing these goods, as it does in the Dyeing of raw Cotton—which has already been mentioned in Section first.

AURORA, RED, AND YELLOW.

THIS is the place in which these colors ought, according to the rotation adopted for arranging the succession of colors, to be treated upon; but as none of them are adapted to this description of goods, it would only be burthening these pages with matter that would be perfectly useless in application. It is merely to show that they were not forgotten as colors, that they are mentioned at all. They are as easy to Dye as any of the preceding ones, but it is of no use to be at the trouble and expense of producing anything for which there is no demand.

Minor Shades of Colors.

These may be considered, in the art of Dyeing, as forming three separate Divisions, varying in their intensity and particular hues, as they have more or less quantity of the Dyestuffs in their composition, employed to produce the orignal color, of which they may be said to be the representative degrees of its scale, or those perceptible differences distinguishable by the human eye.

According to this doctrine, then, when we speak of the shades of a color, we mean some perceptible difference in appearance, as measured by the organ of vision; which being so delicate a metre as to distinguish the slightest difference between light and shade, we may easily imagine what an immense number of differences there must exist in the aggregate of all the colors.

Therefore, it will be readily seen, that to give any written account of the quantities and kinds of Dyestuffs, to produce all the shades, or even any individual shade, without seeing it personally, would be impossible: for the least variation in quantity or quality of Dyestuffs, as well as in other circumstances, are sufficient (in the light shades,) to produce all the effects that constitute the difference between one shade and another. From this you will perceive that the great variety in this intermedial class of colors, or the different shades of Slate, Drab and Fawn, which embrace the minor shades of Black, Olive, and Brown, precludes the possibility of giving recipes that will produce the exact patterns you may have to color to; all that can be done by the writer, not only in these colors but in all others, is to give the formula for such a color or shade of color as he may consider will be a standard or fixed point, from which the Dyer by his skill and experience can tell in what manner to deviate so as to produce the particular color he is desirous to obtain.

Hence, in the following recipes you will find that no particular or definite shade, or arbitrary line of demarkation is aimed at further than what might be the idea of the writer at the time, as the most suitable of several hues to serve as guides in finding out other and analogous shades.

The Principle, or Method and Materials for producing all the shades of the different colors, are embodied in the several processes, and the same mode of operations and kind of materials mentioned in any particular recipe, will, by proportioning them rightly, produce every variety or shade in the same family of color, of which that recipe may be considered as the centre.

All the recipes in the book are to be considered in the above light.

Although the following recipes are all calculated for Dyeing with the Reels only, yet they can all be produced (and perhaps full as good) by coloring in the Dyeing process, with the Machine or Roller apparatus.

In this last plan of Dyeing, it will be necessary to have your Dyeing liquor much stronger than when coloring by the Reels altogether, and you will have to *regulate the heat*, in order to keep the Cotton and the Wool both of one depth of color whilst Dyeing. There is no harm or danger of the Cotton getting more than its appropriate share; but there is considerable difficulty in preventing the Wool from doing so; therefore, whenever you perceive the Wool to be gaining the ascendancy, take the goods up and air them; lower the temperature of the Dyeing bath greatly, and strengthen the liquor considerably, by the addition of more of the kind of Dyeing materials you are using for producing the color then under operation: re-enter the goods, and be careful not to raise the heat again until the color of the Cotton is far ahead of that on the Wool.

By attention to these particulars, you will produce any shade or Color with one liquor, and in any of the cases where you fail in depth of color on the Cotton, you can remedy the mischance by the Tannin and Mordant processes used cold, or nearly so, and with a slight amount of drugs. But make it a settled point, in Dyeing these Cotton and Wool cloths, always to get the Cotton part well bodied up or Dyed first, and the Wool part will be sure to follow as the time goes on, and the heat increases.

These remarks hold good, not only in these shades alone, but also in all colors on this description of cloth.

Minor Shades of Black.

DARK SLATE.

Dyeing Process—by Reels.

Logwood, 32 lbs.
Fustic, 8 lbs.
Sulphate of Copper, 5 lbs.

After boiling the Dye-woods as usual, and dissolving the Sulphate, enter the cloth at one hundred and eighty degrees, running them for about one hour; gradually bring up the heat and boil ten or fifteen minutes: then take out, air and drain.

Tannin Process.

Shumac, 16 lbs.
Logwood, 12 lbs.
Soda Ash, 1 lb.

Boil these together, and take the clear liquor; then run the Pieces five Ends through this, and leave them in all night; cold in summer, lukewarm in winter.

Mordant Process.

Pyrolignate of Iron, 6 pints.
Bisulphate of Copper, 2 lbs.

After draining from the Tannin liquor, run the Cloths four or five Ends through this at the common summer heat, and allow them to remain an hour before taking out.

The hue or tint of this color may be varied, by using eight pounds of Cutch in place of the Fustic employed in the Dyeing process.

RED SLATE.

Dyeing Process.

Logwood 16 lbs.
Hypernic, 8 lbs.
Fustic, 8 lbs.
Sulphate of Copper, 4 lbs.

Mix, bag and boil the Dye-woods for one hour; take out the bags and add the Sulphate; then run in the goods at one hundred and eighty degrees: bring up the heat to a boil, which continue for a quarter of an hour. Take out, air and drain.

Tannin Process.

Shumac, 16 lbs.
Logwood, 8 lbs.

Take the clear liquor of these: run the Cloths five Ends, and allow them to remain in the Tannin bath all night. In the morning take out and drain well.

Mordant Process.

Pyrolignate of Iron, 4 pints.
Protosulphate of Iron, 4 lbs.

Run the goods through this bath for five Ends, and leave them in one hour. Temperature—summer heat for both the last processes.

COMMON SLATE.

Dyeing Process.

Cutch, 12 lbs.
Logwood, 8 lbs.
Sulphate of Copper, 2½ lbs.

Boil out the Cutch and Logwood before dissolving the Sulphate, and when the whole are in solution, enter the Cloths at one hundred and eighty degrees: and whilst Reeling, gradually bring up to a boil, which continue for a few minutes, and take out to air and drain.

Tannin Process.

Shumac, 8 lbs.
Logwood, 8 lbs.

Take the clear liquor of these and run the goods five Ends, at the common temperature of the water, and let them remain in all night.

Mordant Process.

Pyrolignate of Iron, 4 pints.
Proto-sulphate of Iron, 2 lbs.

After draining the Cloths well, give them four or five Ends through this and leave them in the liquor for an hour. This bath is to be used at the common temperature of the water in the summer season.

Any of the shades of Slate can be Dyed by the reverse method of this; that is, by going through the Tannin and Mordant processes before Dyeing off; only not forgetting to wash off out of the Iron before proceeding to finish in the Dyeing bath.

LEAD.

Tannin Process.

Shumac, 8 lbs.
Logwood, 8 lbs.
Fustic, 2 lbs.

Boil these up, and take the clear liquor into the Tannin bath at a lukewarm heat, run the goods five Ends: let them soak in it all night.

Mordant Process.

Pyrolignate of Iron, 4 pints.
Proto-sulphate of Iron, 4 lbs.

Run the goods five Ends, and then lay down in this liquor for an hour: take out, drain and wash.

Dyeing Process.

Logwood, 8 lbs.
Cutch, 2 lbs.
Sulphate of Copper, 2 lbs.

Boil out the Logwood and Cutch before giving the Sulphate, enter the Cloth with the temperature of the Dyeing liquor at one hundred and thirty degrees, to commence with; and whilst Reeling, bring the heat up slowly to one hundred and ninety degrees, taking about three-fourths of an hour, when it will be finished. It will be best to boil up the Logwood and Cutch in a small vessel by themselves, and pour their clear solution into the Dyeing Kettle, instead of boiling in the Dyeing vessel, and waiting until it has time to cool down to one hundred degrees (except in the case of using steam,) you can boil any small quantity of liquor, and cool down by filling with cold water.

LEAD.

ANOTHER METHOD.

Tannin Process,

Shumac, 8 lbs.
Logwood, 8 lbs.
Cutch, 4 lbs.

Take the clear liquor of these into the Tannin vessel, and run the goods five Ends at the common heat of the water in summer, and in winter, lukewarm: let them remain therein until morning.

Dyeing Process.

Protosulphate of Iron, 4 lbs.

Dissolve this in the clear water of the Kettle, at one hundred and thirty degrees, and run the Cloths through it at that temperature for about half an hour: then take them out.

Whilst the Cloths are airing, dissolve in the Iron-liquor of the Kettle,

Hematine, 2 lbs.

or pour into it the strength of

Logwood, 8 lbs.

Then re-enter the Pieces, and whilst Reeling, bring up the heat gradually to one hundred and ninety degrees, taking up about three-fourths of an hour's time, when they will be finished.

The goods before going into the Iron solution, ought to be thoroughly drained from the Tannin liquor.

Minor Shades of Olive.

DEEP DRAB.

Tannin Process.

Shumac, 12 lbs.

TAKE the clear liquor of this, and run the Cloth five Ends through it cold, and leave them in all night.

Mordant Process.

Pyrolignate of Iron, 4 pints.

After draining the Cloths from the Shumac-liquor, run them through this five Ends, and let them soak an hour: take out and wash: then drain well. Iron, cold.

Dyeing Process.

Cutch, 12 lbs.
Fustic, 6 lbs.
Hypernic wood, 6 lbs.
Logwood, 3 lbs.
Sulphate of Copper, 4 lbs.

Boil up the Dye-woods, and throw out the bags: add the Sulphate of Copper; then enter the goods at one hundred and eighty degrees, and while Reeling bring up to two hundred degrees: let the operation last three-fourths of an hour.

This method may be reversed, by commencing with the Dyeing process first; entering the Cloths at one hundred and thirty degrees, bringing up the liquor (whilst Reeling,) to a boil, and continuing the ebullition ten or fifteen minutes; using eight pounds of Shumac in the Tannin process, and soaking in it all night; then finishing off in the Mordant process, with six pounds Sulphate of Iron. Both these last processes are to be employed cold.

RED DRAB.

Tannin Process.

Shumac, 8 lbs.
Cutch, 4 lbs.

Use the clear liquor of these, and run the Cloths five Ends, cold or merely lukewarm, and leave in all night.

Mordant Process.

Proto-sulphate of Iron, 8 lbs.

Employ this solution cold, and run five Ends; then soak the Cloths for one hour. Take out and drain well.

Dyeing Process.

Cutch, 6 lbs.
Fustic, 4 lbs.
Hypernic, 8 lbs.
Logwood, 1 lb.
Sulphate of Copper, 2½ lbs.

Take the clear strength of the Dye-woods, and dissolve the Sulphate with them in the Dyeing bath: into which enter the Cloth at one hundred degrees, and whilst Reeling, bring up the heat to two hundred degrees. Let the operation take up three-fourths of an hour.

The Dyeing Process may be taken first, if thought more advisable, only using four pounds Sulphate of Copper, in place of the quantity above enumerated.

ESTERHAZY DRAB.

Tannin Process.

Shumac, 12 lbs.
Cutch, 6 lbs.
Logwood, 6 lbs.

Enter the Cloths into the clear strength of these drugs, at one hundred and twenty degrees: Reel five Ends, and let them stay in all night.

Mordant Process.

Nitrate of Iron, 2 pints.
Proto-sulphate of Iron, 6 lbs.

After draining from the Tannin liquor, run in this cold liquor five Ends, and leave in one hour: take out, wash and drain well.

Dyeing Process.

Catechu, 12 lbs.
Hypernic, 8 or 12 lbs.
Logwood, 4 or 6 lbs.
Sulphate of Copper, 4 lbs.

Boil out the Dye-woods and withdraw the bags: dissolve the Sulphate, and enter the Cloth at one hundred and eighty degrees, and whilst Reeling them bring up the liquor to a boil, run an End or two, and then take out.

This Color can be made either Bluer or Redder, by judiciously proportioning the Logwood and the Hypernic wood; and it may be flattened down (if required) by the addition of a little Sulphate of Iron, in the Dyeing bath.

STONE DRAB.

Tannin Process.

Shumac, 12 lbs.
Cutch, 6 lbs.

Dissolve the Cutch and Shumac by themselves, and take their clear liquor for use in the Tannin vessel: then run the Cloths five Ends through this whilst cold, and leave them in all night. In the morning take out and drain.

Mordant Process.

Proto-sulphate of Iron, 8 lbs.

Dissolve this in a Kettle of cold water, and run the Cloths through it for about three-fourths of an hour: take out, and after letting them drain awhile, enter them (without washing,) into the

Dyeing Process.

Cutch, 10 lbs.

Dissolve this in the Kettle at one hundred and seventy-five degrees; enter the Cloths, and whilst Reeling, bring up the heat to two hundred degrees. In about an hour after commencing, the Color is done.

Another shade of this Drab will be obtained by treating the goods with the cold Tannin Process, as above, and next morning taking them out, and dissolving four pounds of Sulphate of Iron in the same liquor: then re-enter the same Pieces, and whilst Reeling apply either the fire or steam, and bring up slowly, during which time, take off samples of the Color, and as soon as it arrives at the desired shade, take out the goods, air and wash.

SILVER DRAB.

Tannin Process.

Catechu, 8 lbs.
Bisulphate of Copper, ½ lb.

Dissolve in a suitable vessel (with boiling water,) the following ingredients, and pour them into a Kettle of clean water, at the temperature of one hundred degrees: turn the goods five Ends, and let them soak all night.

In the morning, take out and drain well.

Mordant Process.

Proto-sulphate of Iron, 8 lbs.

Dissolve the above in a vessel of cold water, and run the Pieces through it for half or three-quarters of an hour.

Dyeing Process.

Run off full two-thirds of the liquor of the vessel in which the Cloths were soaked all night, and then fill it up with water again; now enter the Cloths into this (without washing them from the Mordant Process,) at the temperature of one hundred and twenty or one hundred and thirty degrees; and while turning them through it bring up the heat a little, but do not exceed one hundred and seventy-five degrees. Take them out whenever they arrive at the desired shade, independent of the heat, or any other circumstance.

This Drab may be Dyed without the intermediate process of Ironing in a separate operation, by emptying the Tannin bath two-thirds—running up with water—using four pounds Sulphate of Iron with the same liquor, and raising the heat; but the Color is not so clear as when Ironed separate—as above.

SAGE DRAB.

Tannin Process.

Catechu, 8 lbs.
Logwood, 12 lbs.
Fustic, 8 lbs.

Pour the strength of these into the Tannin bath: run the Pieces five Ends through this, having it lukewarm, and leave them in all night.

Mordant Process.

Bisulphate of Copper, 4 lbs.

Dissolve this in a pail or two of hot water, and pour into a Kettle or Box of clear, cold water, and after the Cloths have drained well from the Tannin liquor, enter them into this and run them for nearly an hour; then take out and (without washing) enter them into the

Dyeing Process.

Logwood, 4 lbs.
Fustic, 4 lbs.
Catechu, 1 lb.

Run them in this for about three-fourths of an hour, beginning at a temperature of one hundred and thirty degrees, and running up the heat towards one hundred and seventy degrees—which do not exceed. Take out when deep enough, without regard to heat or time.

For deeper or lighter shades use more or less Logwood and Fustic; and for a Yellower hue, give more Fustic; for a Bluer, use more Logwood. If wanted duller, or more of a Stone Drab hue, use more Catechu: or, after running awhile in the Dyeing bath, raise the Cloth and give a little Sulphate of Iron: re-enter the goods. and run a few Ends.

Minor Shades of Brown.

DEEP FAWN.

Tannin Process.

Shumac, 8 lbs.
Logwood, 8 lbs.
Cutch, 8 lbs.

USE the strength of these, and run the Cloths five Ends in it at the temperature of one hundred degrees, and soak all night.

Mordant Process.

Bisulphate of Copper, 4 lbs.

After the goods have drained from the Tannin liquor, run them five Ends through the cold Mordant liquor, and let them remain in it an hour or more: take out, drain (without washing,) and pass them to the

Dyeing Process.

Catechu, 12 lbs.
Fustic, 4 lbs.
Hypernic, 4 lbs.
Sulphate of Copper, 4 lbs.

Take the strength of the above Dye-woods, and dissolve the Sulphate with them in a bath of water at one hundred and fifty degrees: into which enter the goods, and while Reeling them bring up the temperature towards one hundred and seventy-five degrees —which do not exceed: when the Color is sufficiently up, take out.

Another shade of this Fawn Drab may be obtained, by taking one-half of all the ingredients named, and proceeding as above stated. In either of the two shades you can *flatten* the hue or bring it more towards a Drab, by raising the Cloth out of the liquor, towards the end of the Dyeing Process, and giving a little Sulphate of Iron.

FAWN DRAB.

Tannin Process.

Cutch, 8 lbs.
Nutgalls (ground,) 4 lbs.

Boil these in a suitable vessel, and then pour the whole through a coarse seive into your Tannin bath of clear water, at one hundred degrees. Run the Cloths five Ends, and let them remain in all night.

Mordant Process.

Bisulphate of Copper, 8 lbs.

After draining the Pieces from the Tannin liquor, run them five Ends through this at one hundred degrees, and let them lie in it an hour.

Dyeing Process.

Catechu, 8 lbs.

Dissolve this in about seven or eight gallons of boiling water, and pour it through a seive into the water of the Dyeing bath, heated to one hundred and thirty degrees. Take the Cloths, only slightly drained from the Mordant liquor, (two or three pails of which you may add to the Dyeing bath,) and enter them into this, and while Reeling, bring up the temperature to one hundred and eighty degrees: whenever the Cloths are evenly Dyed, and the Color suits you, take out the goods; but in running the Cloths, whatever length of time it may take in bringing up the depth of shade, do not allow the heat to exceed two hundred degrees.

If you want to *flatten* the hue of the Color a very little, Sulphate of Iron will do it; or a few quarts of old refuse Black liquor will answer the same purpose.

As Fawns are but little called for on Fulled Cloths, it is useless to give any more examples; as almost all their shades depend upon the greater or less quantities of the Dye-drugs, used in the examples here given, from which an experienced Dyer will produce any variety that may be wanted.

Catechu and Cutch have been selected from many other Dyeing materials that produce the Fawn shades, on account of its great affinity for the Cotton part of this fabric, and the ease with which it can be applied by simple operations.

The great Principle for our consideration, not only in these particular shades, but in all other colors and their various shades, is, how to Dye the Cotton and Wool, or other material, precisely alike.

In the case of coloring Fawns, we obtain this result very easily, by using the Cutch or Catechu, &c., cold, or nearly so; which gives a body to the Cotton before the Wool has scarcely become affected, and the subsequent warm Dyeing by the same or other materials, takes some, both on the Wool and also on the Cotton, thereby turning out a Color of the same hue and depth on both.

Brighter shades of Fawn than those given by Catechu and Cutch can be obtained by other Dye-drugs, but they are more costly, less permanent, and require more operations, and color with greater difficulty than by the two preceding articles. Madder, Camwood, Barwood, Hypernic, Fustic, Quercitron Bark, and a variety of other coloring matters may be employed: but the Cutch and Catechu are preferable on almost all accounts.

THE EPITOME OF DYEING COTTON AND WOOL CLOTHS.

In commencing so intricate a piece of work as the Dyeing of a complex fabric, like Wool and Cotton Cloths in the Piece, it is essential that we should not only begin *right*, but that we should be carried through all its stages correctly, and terminate *right*.

The Principles, Methods and Materials by which this compound fabric is most easily Dyed with the several Colors, are scattered—in appropriate places—through the preceding pages; but these being the vital elements of this branch of Dyeing, without a close adherence to which, it is impossible that success should attend the efforts of the Dyer, I cannot conclude this Treatise, without collecting these particulars into one contiguous body, and laying them down as Fundamental Rules—or as axioms—in Dyeing, which cannot either be slighted or departed from with impunity.

They are the very Spirit of the Art. For this reason I reiterate them, so that they may be indelibly impressed upon the mind of the Dyer, as those circumstances under which he has either to fail or succeed in the object of his attempts, in this particular department of Dyeing.

Therefore, I call his earnest attention to the following observations, and recommend him to study them thoroughly, and act upon them with the most undeviating constancy, as those *principles* upon which depend the successful results of his operations.

1.—The first essential point to be observed, is of as much consequence to the Manufacturer as to the Dyer, and it is his peculiar province, or that of his Superintendent, to see that the goods are delivered to the Dyer in the best possible condition for Dyeing, of which state the Dyer is the only legitimate judge.

It is a duty that the Dyer owes to himself, to his character and reputation as a workman, to insist—at all times—upon those conditions being fulfilled, which he considers as indispensable to the ease and certainty of coloring these, or any other description of goods; and it is the interest of the Manufacturer to sustain him at all times in these reasonable demands, by seeing that the Dyer has the goods delivered into his hands, in the condition he requires.

Under these circumstances, all other persons will be exonerated from blame for any mischance that may happen in the subsequent operations of Dyeing.

These conditions for Cotton and Wool-made Cloths—the kind of fabric now under consideration—are, that they be thoroughly Carded, effectually Scoured and Fulled, and completely freed from Soap and Grease: then entirely Raised and Napped, Dried and Cropped well down, and sent in this shape to the Dyer, who will, under these circumstances, have a fair chance to color both the Cotton and the Wool.

These circumstances, you will bear in mind, are essentially the best condition in which the Cloths can be placed for imbibing color, and on no account whatever should the Dyer or the Manufacturer allow any of them to be neglected or dispensed with.

2.—We now suppose that the Dyer has got the goods into his charge precisely in the shape he wishes them: we have, therefore, to consider what are the best means of coloring them. In the first place, the preparation of the different liquors or baths employed in producing the Colors, attracts our attention: these should, in all cases, when ready to receive the Cloths, be perfectly free from everything of an insoluble nature; that is, they should be clear solutions or *aqueous tinctures* of the drugs employed in each particular Process or Color. To make them in this shape, we ought either to employ Extracts (liquid or solid,) of the different materials or (if we have to operate upon them in the rough or crude state,) we must, in order to get clear Dyeing liquors, either boil these out in a separate and suitable vessel, or otherwise boil them in bags, in the coloring-Vat itself: any of these three plans are left to the choice of the Operator himself, who, of course, has in most cases, to be governed by circumstances: but, however he may be situated in these respects, let him be aware that it is greatly to his advantage to have clear solutions in every process of coloring. In using the Metallic or other Chymical Salts, take care that these are completely dissolved in the bath, before entering the Cloths.

By loading the Dyeing liquors with loose Dyestuffs, it not only manifests a slovenly and ignorant mode of workmanship, but is worse than useless, as it is highly injurious to have them in the Kettles at all whilst coloring; for by their weight in the Cloth it is more laborious handling the goods, and the danger of having them spotted or uneven is greatly increased by the presence of this worthless refuse.

It is, therefore, not without reason, that the attention of the slovenly and filthy Dyer is particularly called to this subject. The neat and skillful workman will need no reminiscence of it, as he will be careful, not only in this respect, but in all other matters regarding cleanliness, about the Dye-house.

3.—The liquor being now ready for the Cloths, we have them neatly folded or cuttled up in front of the Kettle, so that in entering they may run into the liquor in a straight and even manner; by which means all parts may have an equal chance to imbibe the strength of the liquor alike. Run them from End to End five times, or until they are completely wet with the solution: if it be in the Tannin Process, then lay them down for the night (all parts being put under the liquor:) if for a Mordant Process, an hour or two will be sufficient: if in the Coloring or Dyeing Process, to keep them moving during the whole time of Dyeing is the safest way.

The Temperature at which the different baths are to be used depends upon the Color to be Dyed, and on other circumstances which are given in the recipes of the several Colors, all by Fahrenheit's scale.

4.—On taking the Cloths out of any process (with very rare exceptions,) they ought to be thoroughly drained before entering into the succeeding one.

If there is an Extractor in the establishment, by all means make use of it for this purpose, as it amply repays the little trouble of the operation, by the increased facility with which the Cotton will take up the strength of the liquor or dip. When taken from the Extractor, let them be folded neatly before the vessel into which they are going to be entered; in fact, at all times, when the goods are out of the Ketttles, any neat and tidy Dyer will keep them in a straight and workmanlike shape, either on the Horses or other draining apparatus.

5.—Give the Cloths as much time as you can possibly spare between the several Dips, especially when you have to Shumac and Iron, and particularly for dark or deep Colors; as by letting them lie some time after they come out of the Tannin and Mordant processes, the materials that have been employed in these Processes still continue to act by age and exposure to the air, and will form a more durable and intimate combination with the Cotton, than they would do if taken immediately from one Process into another.

Even after they are fully colored, do not allow them to go directly to the washing, but give time for the Color to fix itself fairly and assume its utmost intensity before washing off. The heavy Colors (if time permits,) ought to lie all night before going to the water, which is the only thing required for washing off any of the Colors, Dyed according to the foregoing recipes.

These observations apply equally to the Reel-Dyed Colors, and those Dyed by the Machine.

Of such consequence do I consider the observance of the foregoing rules to be, in order to insure success in Dyeing these fabrics, that I cannot avoid an inclination to repeat them in a very abridged form, so that they may be more easily borne in memory at all times during the management of the operations to which they relate:

1.—The Goods are to come to the Dyer, Cleaned, Cropped and Dry.

2.—*The Coloring Liquors.*—These are to be clear solutions of the coloring matters or Mordants, only.

3.—*Manipulations of Dyeing.*—The Cloths are to be run into the Kettle at their full breadth, and kept so during the whole time of turning, which in every case is to be until all parts of them are equally saturated with the liquid through which they are passing.

4.—*Draining between Operations.*-The goods are not to go into the liquor of a fresh bath, until drained as much as possible from that which precedes it.

5.—*Aging the Colors.*—Allow them as much time as possible for airing and draining between one Dip and another, and also between the last operation of Dyeing and the washing off.

6.—Wash off with water, only.

7.—The judicious and economical management of the Dye-stuffs is a matter of the greatest interest to those who have to purchase them; but no written means of doing this can be given as a standard rule: this part of the business depends entirely upon the prudence, skill and experience of the Dyer, in knowing how to work up to the utmost all the available properties of the different materials he has to operate upon; and the only means to insure Economy of Dyeing that can be confidently recommended to a Manufacturer, is, to employ none but regularly-initiated Dyers, who, by skillful tutelage and extensive practice, are qualified to conduct in the most satisfactory manner the tedious and expensive operations of Dyeing. These are the Artists, and they alone, who produce the most desirable Colors, at the least possible expense of Materials. The thousand and one Quacks, that are employed, at present, in this complicated and costly business, are a standing curse to the workmanship of the manufactories, and continual drains upon the purses of the Manufacturers.

———o———

Something might be said in regard to Yarn Dyeing, when composed of Cotton and Wool; but as this subject was not calculated to be embraced in this work, I shall make no observations on this topic, further than merely to observe, that the Dyer of this kind of Mixed Yarns, may take the recipes here laid down for the Dyeing Cloth by the Reel, as a GUIDE in directing him how to proceed in the formation of Colors for Dyeing Yarns, composed of Cotton and Wool; only reckoning, that for each recipe the quantity of every one of each material will be equivalent to every one hundred and fifty pounds of Yarn (scoured,) that he may have to color.

He will have to observe the *Time* and the *degrees of Temperature* here laid down, exactly as if for Cloth Dyeing. In other respects, he must operate as usual after common methods of Yarn Dyeing.

These are the concluding remarks:—and in taking my leave or farewell of my Brother Dyers, of every Nation, who may happen to come across these, my observations on their Art, I expect that they will view my labors simply as the effort of an unlettered individual of their Profession, to promote the welfare of our common craft, rather than to consider that I have written this with any view to personal aggrandizement, or with the expectation of making every man who should purchase or read this work—a Dyer. The intelligent men of this Profession will exonerate me from entertaining any such foolish notions.

THE
SYSTEM AND SCIENCE OF COLORS:
OR THE
PRINCIPLES AND PRACTISE
OF
WOOLEN DYEING,
WITH AN ACCOUNT OF THE
PROPERTIES AND COMPOSITION
OF THE
Dyestuffs and Chymical Compounds
WHICH ENTER INTO THE
CONSTITUTION OF COLORS.

PREFACE.

THE ornamental and useful Art of Dyeing, although one of the very first to which the genius of man was directed, and now become, in a manufacturing and commercial point of view, of vital importance to millions, hath not, until very recently, engaged the least attention from men of Science, and but now and then a passing observation, even from any of those who were immediately connected with its pursuit.

A few practical Dyers have, from time to time, given us a transitory glimpse at the mysteries of their profession, in the form of recipes of materials, and accounts of some processes for producing such and such colors.

Many of these recipes and processes (especially of the olden Dyers,) are now become useless, better methods and materials having been discovered; but some of them cannot be improved upon, and will continue to be employed, so long as Dyeing shall be profitably followed.

But none of these writers have attempted, either to explain the operations of the Art upon Physical principles, or laid down the least outline of a Systematic arrangement of its parts.

However, within the last twenty or thirty years some eminently scientific names appear as contributors to the elucidation of this Art; among whom are Macquer, Braconnet, Barthollett, Bancroft, Parks, &c.; and although not any of these were, strictly speaking, practical Dyers, and as a consequence of this, none of their recipes or processes can, with certainty, be depended upon, or be applied profitably in practice, at the present time, yet by their profound investigation of its processes, and their elaborate and correct analysis of its materials, and by identifying its principles as connected with Chymical Science, they have raised it into notice and given it pre-eminence as one of those arts dependent upon Chymical knowledge for their successful pursuit.

They have given us useful descriptions of the Dyestuffs—if vegetable; where raised; how cultivated and manufactured;—if chymical, (by analysis,) what is their composition, habitudes and adaptation.

They have shown a clear and correct explanation of the chymical changes that take place in many different processes of Dyeing, and have accounted in a satisfactory manner for some of the most complicated and inexplicable combinations in any department of the Arts—namely, what is called the Turkey Red Process.

All this they have done by a course of long and tedious, but patient and very skillful investigation. Their labors have, therefore, been very beneficial to the business, in calling public attention more to it; in elevating it to its proper rank as an Art; in arousing the dormant energies of Dyers to its study upon Chymical principles, and in giving the first impulse for the overthrow of that hap-hazard, blindfold routine upon which it had been hitherto conducted; in affording light, and a guide for the direction of those who practice the mysterious processes which adorn the person or the habitation of man with colors, vieing in beauty with the tints of the enameled mead, the glittering plumage of the feathery tribes, or the rich splendors of the variegated rainbow.

For the aid that this beautiful Art has received from these illustrious men, not only Dyers, but also manufacturers, commercial men, and the world at large, are greatly indebted. Nevertheless, neither these eminent men, nor the practical writers before alluded to, have attempted to show anything like a System of Colors, or even to form a regular classification of its parts or colors, according to their natural order of development. There, therefore, wants some methodical arrangement, to simplify it for the learner, and to make the study of it more easy and pleasant. The object of this writer is to make an attempt to satisfy these requirements by endeavoring to produce a Work that shall be arranged and classified in a Methodical manner, in regard to the various subjects of Colors and Dyeing, upon which it treats. And also to show that there really does exist a Natural System of Colors, all the parts of which act together in concert and form one harmonious Whole.

The reader, in perusing this Treatise, in order to form a correct estimate and gather the complete sense of its contents, ought to commence at the beginning and proceed through the whole Work, in a regular course of reading, in a straight forward manner, and then he will find that it is a *connected whole*, each part bearing a relation to every other part, and forming a portion of one continuous Plan; that all its subjects are arranged in a regular order of progression; that it is a Systematic Work, which, taken as a whole, is a "Complete Study of the Nature of Colors, and the Art of Dyeing." He will also bear in mind to make an allowance for some of the dates of time, this work having been written seventeen years ago.

ON THE CONSTRUCTION AND ARRANGEMENT OF A DYE-HOUSE.

DYEING is on all accounts the most important branch of the Woolen Manufacture, for on the excellence and economy of the coloring mainly depends the character and the profit of the establishment. How necessary it is, then, that every manufactory should be provided with a convenient Dye-house, proper apparatus, good dyestuffs, and an experienced dyer; and yet how little, comparatively speaking, are any of these requisites attended to; for it seems to be the common and prevailing opinion that a Dye-house is a kind of a wet, dirty place, and it will do if it be fixed *anywhere*, or constructed *anyhow*—that any sort of a vessel, no matter what shape and size, if it will hold water and can be made to boil, will answer as well as one of any other size, shape or material, and it is only the whim or old-maidish fancy of the dyer, that makes him propose kettles or vats, of such and such forms, sizes and materials —that good dyestuffs cost more money than inferior kinds, and that these last are just as good, only use more of them—that an experienced and first-rate dyer cannot be had at as low wages as a man who has had an opportunity of working a few months in a Dye-house, consequently there must be a saving by hiring the latter, of so much per week in wages, which is a consideration. Such are the conclusions of inexperience, and such is the language of ignorance! But knowing that these things are not so, it becomes a duty in me to describe, for the information of those who are willing to receive instruction, and who are interested in the erection of so important a building as a Dye-house, not how they *are*, but how they *should be* constructed, so as to combine comfort, convenience, and economy together.

With these objects in view, I shall commence by stating that the size of the building must always be proportionate to the quantity of work expected to be done in it; and its location should be such that there will be plenty of light, a good supply and fall of water, a free circulation of air, when needed, and as much as possible one steady temperature. Its walls should be built of brick or stone, being best calculated to preserve a regular degree of heat and prevent accident by fire; they should be ten feet high from the floor to the square, and as much higher as you please—the building open to the roof, and the whole interior well white-washed, at least once a year, so that it may aid the windows in diffusing the light, preserve cleanliness, and promote health and good nature in the workmen. There should be a large window in the side walls, opposite each vat or kettle, so that a flood of light may come beaming directly upon the work, and enable the dyer to perceive distinctly the progress of his colors, or the state of the liquors.

There should be one large main sewer, running (under the floor) the whole length of the building, into which other smaller ones from each kettle or vat, and also from the wash-boxes, should empty themselves. The floor of the Fancy Dye-house and wash-house should so incline that all the wet may run off them into this main sewer. There should be square holes in the floor at the letting-off place of each kettle and vat, which should have trap-doors to them, fitting even with the floor; and these will keep down the cold in winter, and prevent the workmen from slipping down and breaking a limb, or scalding themselves, of which I have known instances for the want of them. There should be a division wall from top to bottom between the Blue and fancy Dye-house; or, what is better, a room should be made between them for the scouring and washing, communicating by doors with each of them, and these doors sufficiently large to admit bags of wool, &c., to pass through them easily. One external door should be large enough to allow of the ingress or egress of any vat or kettle for repairs, &c., without having to take down the walls for that purpose, which also I have seen done.

In the roof of the building over each kettle, a square hole ought to be left, from the top or outside ot which should rise a pyramidal conveyance for the steam, of about three feet in height, more or less, and narrowing so as to leave an opening at the top of it of six to nine inches square; this is to have a trap-door or lid, to be shut nights, or in cold weather, and for this purpose must have some contrivance to open and shut it by, from the inside of the Dye-house; the Blue Dye-house may, or may not want these ventilators.

The floor of the whole building should be on one plane or level; not stairs out of one place into another, recollect, nor stages around kettles or vats, nor any such like contrivances or conveniences of that kind. The vats not only should not, but must not be set higher than two feet eight inches from the floor to the curve, and the kettles of a small kind, at the height of about three feet; those of a larger size will do a little higher, but not so high as the workman's head. I was once called to a case of that kind.

The vats should range parallel to each other, and ought to stand three feet from the side wall; three feet from the end wall; and three feet from each other, and as much further as you think necessary. It is better to have too much room, than to have the vessels cramped up, which is a very common and a very great fault and inconvenience. The kettles should also stand parallel to each other, and they may be set up to the side; but, mind, do not corner them up,—therefore, leave at least three feet space between the kettles, and more if they be very large, and plenty of room from the end walls. The scour-kettle may stand about the same height from the floor as the vats, and may be so situated as regards the wash-box that the scoured wool may be tipped right over into the box, from the kettle, without straining the workmen to death, in lifting or carrying it a distance from one to the other, filthying up the floor with scour-liquor, and wasting time in this transfer, all which is unnecessary, looks slovenly, and shows want of judgment and taste in those who have so arranged it. The chimney should set in, or up to, the side walls; not brought forward into the building to incommode the workmen, or take up valuable room. Stoves should also be placed in this building to keep it of a comfortable temperature during the night or in the winter season.

There should be a metallic pipe (lead is the best) of three or four inches bore, running along immediately behind, and upon a level with, the curves of the kettles, for the conveyance of water into them, and a stop-cock should branch from the main pipe to every kettle. There should be two wash-boxes, at least, in a large Dye-house, one for the white wool and another for such colors as require washing, and they may be made about three feet wide, six long, and three deep, with a double bottom, the upper one being about six inches from the lower or real one; the upper one is in general made of copper or zinc perforated with small holes; but the best and most durable kind that I know of, are made of cast iron, four plates or pieces of them fitting the box. These plates or pieces are made grate-like, having longitudinal slits of one-eighth to one-sixteenth of an inch wide, and at the distance of an inch apart. The whole breadth of the bottom, and the whole surface of this grating on the upper side, is smooth and level, only having these slits in it; but the under part of it is cast after a different fashion, the iron of each division flaring away from the slits almost to an edge, and by this form leaving a free passage and fall for the water to drain out of the wool. That side of the wash-box which is nearest the workmen should be an inch or two higher than the other parts of it, so as to prevent him getting wet with the water. There is a gate at each end of the wash-box to let the water in and out of it, the water coming in level with the top of the upper-bottom, and going off level with the lower bottom.

But the principal objects to be had in view in constructing wash-boxes, is to have the water enter in quantity and with force sufficient to agitate every portion of the wool; to settle off quick and without losing any locks.

Three or four feet of the floor round the wash-box may be sunk six inches lower than the main part, having a small outlet for the water coming from the wash-box and the drainer into which the washed wool is thrown. This prevents its running over the floor of the wash-house or Dye-house: then into this sunken part let a kind of trellis-work fit neatly and level with the main floor; upon this the workman stands as dry and comfortable as it is possible in such kind of work. A hint to the wise is sufficient. "The righteous man hath regard to the life of his beast." This text will be extended in its application by all those who have any regard for the comfort and well-being of their fellow-men when employing them in any occupation whatever.

The form of kettles for wool-dyeing should be a little deeper than their diameter; the bottom convex internally, or so as when seated on the furnace to form a flat kind of dome over it; the sides should ascend to about two-thirds their height, with an outward inclination, and then incline inwards again to the rim, this form throwing the boil from the sides towards the center, and preventing its boiling out in a great measure; the form of the bottom also causes a boil in the middle; so by this construction the vessel boils in all parts alike, which is very necessary to the production of even colors. A pipe, with a stop-cock attached to it, should extend from the kettle to the outside of the brick work, to let off all the liquor from the wool in emptying the kettle. The flange or curve of the kettle should be broad enough to cover the whole top of the brick work surrounding the kettle. This brick work is to be built *round*, not in a square form, about the kettle, because being built of the same shape as the vessel, it takes up less room and fewer bricks are required. When they do these things in the neatest and most workmanlike style, they have bricks cast purposely for this particular use,—not square-sided brick, such as are employed in building houses, &c., but rounding off, so as to form the segment of a circle, which makes the bricklayer's work look much better and last longer. Iron vessels will answer for all the colors belonging to the Intermediate, Tertiary and Aggregate Classes, but for very bright colors, and where the solutions of Tin form the mordant, Tin vessels ought to be employed; for other colors, Copper; and where much Sulphuric acid is employed, as in dyeing chemic green, lead vessels will be most proper. But in the United States, copper vessels are pretty much the only kind employed, especially in wool-dyeing, which answer most purposes very well; in fact copper is better suited for general use in all colors upon wool than any other metal, so that for most purposes copper vessels are the cheapest and best: though they are not the best for *every* color.

The capacity of the kettles may be about two and a half gallons of water for every pound of wool to be colored in them. The scour-kettle may be either of copper or iron, and its form flat or concave in the bottom and straight on the sides; its size not very material, only having a proportion to the quantity of work likely to be passed through it in a day; but perhaps one containing from 100 to 150 gallons will be found as convenient a size as any other. Common sized vats of six feet diameter and seven deep, are as convenient a capacity as can be desired for the general run of Dye-houses, and will hold about fifty pounds of scoured wool each: the sides built perpendicular and the bottom flat. They are built of wood in this country, with a circle of copper of about two and one-half feet in width, firmly riveted in the inside to the upper and lower wood parts; this runs round the vat, about mid-height, and a flue is built round it for the purpose of heating the vat directly by fire. I would here suggest as a better mode than the above, for the construction of a vat to be heated by fire—that is, to make the lower part of the vat of wood, in depth four feet four inches; then have the remaining upper part of two feet eight inches made of copper or iron, with a flange or curve to project to the outside of the brick-work; rivet the lower part of this cylinder to the wood-work, and build a fire-place and flue of brick all round the cylinder; the flue may be four inches wide and a half a brick thick for the flue wall, making about eight inches between the outside of the brick-work and the inside of the vat; the joining of the wood-work to the metal should be done neatly, so as to present a smooth inside of the vat, which allows of raking the vat without obstruction: this ought always to be the case with the inside of a vat. By setting the brick-work of this flue with cement instead of common mortar, the vat may be heated by steam by throwing it into the open space between the brick and the metal; it will want a small pipe at the bottom of the brick-work to let out the condensed steam. The best and ultimately the cheapest material for Blue vats is cast-iron; in England they have them altogether of cast-iron, generally cast whole, but sometimes for very large vats they are cast in two parts, the upper and lower parts being joined together by flanges externally, which are secured together and made water-tight. The cost for a new common sized vat is about 40 or 50 pounds sterling; but then they can be heated either by steam or fire, having a flue surrounding the upper part, as described above. When once seated in their places, these kind of vats need no more repairing, and they *last forever.* I have seen vats constructed of lead that have been in use for a century, yet have known one or two instances of these being burnt through and losing the liquor; but this is only of rare occurrence, and might in these cases be attributed to carelessness. But after all, iron vats (when there is a foundry that can cast them) are the safest, the most durable, and ultimately the cheapest. I would here observe, that in heating vats by steam, a small pipe may be conducted into the inside of the liquor, running about half way down; by this a little steam may occasionally be thrown into the liquor, when the vat gets low, in place of filling up with water. But I wish to be understood as not recommending the heating of vats entirely by throwing the steam into the liquor, as this plan fills up the vats too much, besides thinning the body of the liquor and exhausting the strength of the woad too soon. I would also note in this place, that where steam is employed for heating the vats, a small pipe may as well run into each Fancy kettle to aid the fire in raising a boil in the morning and at other seasonable times, when expedition is required; and also to act as a kind of economizer in taking up the surplus steam after the vats have had enough, &c. &c. I am in favor of this double method of heating kettles, in preference to heating wholly by steam in wool-dyeing for the reason that the steam blowing directly into the kettle or tub is very apt to matt, cott, or felt the wool; also, that there are some kinds of the hard resinous dye-woods which do not give out their best qualities, or at least do not yield the same quantity of color by a steam-boil, as they do by the direct application of fire to the kettle. I therefore consider the most judicious use of steam in this kind of dyeing to consist in employing it merely as an auxiliary or assistant to the fire at proper times and for certain ends, and not in making use of it as the principal means for heating the kettles. The same disadvantages result from its application to the scour-kettle; nevertheless, it may be thrown cautiously into the scour-liquor occasionally; but as before said, at considerable risk of eotting or felting the wool; yet it may serve to hasten the elevation of the temperature of the scour, mornings, or at other times, when there is but little wool in the kettle. Notwithstanding its disadvantages in this respect, and my prejudice on that account against its employment as the sole agent for heating a wool Dye-house, yet public opinion has decided in favor of the use of steam entirely for this purpose in nine-tenths of all large establishments.

That the cost of fitting up a Dye-house to be heated solely by steam, is far less than for one by the direct application of fire to the kettles, does not admit of the slightest doubt; and that the expense of the daily consumption of fuel on the two methods is greatly in favor of steam, no one can dispute. As far as outlay of capital is concerned in the fixtures and economy, in consumption of fuel, and other advantages, the balance is decidedly on the side of steam; but I doubt whether these are not counterbalanced by several serious disadvantages attending its application in a direct manner in the dyeing of fine wool, among which disadvantages we may reckon the certain risk of the wool being left more or less felted, or not in that free and open state, neither will the colors be as high or as permanent, as by the method I have described.

For the convenience of transferring the wet wool from the wash-boxes to the kettles, or *vice versa*, and out to the dyeing ground, &c., provide vehicles, (large enough to hold a kettle of wool,) with open sides and bottom, running upon iron axles and cast iron wheels. As to the other utensils and apparatus in use about a Dye-house, they are so few, of so simple a character, and so well known, that it seems needless to describe them, otherwise than to say, that let the article be what it may, to have it made in a substantial and workmanlike manner, and of such a form, material and finish as will be best adapted to execute the work in a neat and expeditious style. I believe I have said all that is necessary in regard to the internal araangement of a Dye-house, and the only change that will be required to make this description answer for steam dyeing, is to substitute wooden tubs or boxes for the metallic vessels described, the arrangement being the same in both cases. In this description there is exhibited a Dye-house 100 feet long and 25 feet broad; 50 feet of its length to hold five Blue vats of six feet diameter each; 25 feet for the scouring room, and 25 feet for the Fancy Dye-house, holding two kettles, each capable of coloring 250 pounds of wool; the whole thus affording plenty of room and convenience for dyeing properly from 800 to 1000 pounds of wool per diem.

Another form of the Dye-house may be as follows: One room of 50 feet in length and 36 feet in width, ranging the vats on one side and the kettles and scouring apparatus on the other, will be large enough to accommodate the same number of vats and kettles, and do as much work as the one of 100 feet by 25 feet, when divided into different partitions; but it is better in many respects, when large quantities of wool are to be colored, to have the different kinds of work in separate apartments. Perhaps this form of a Dye-house will be adopted in preference to the other for small establishments; but leaving this to the judgment of the Dyer, I will proceed to describe the external connection of a well arranged Dye-works.

Directly in front of the building, a platform may be constructed for drying the wool in the summer season. This, at its juncture with the building, should be level with the Dye-house floor, and from thence it should incline gradually away sunward, by a gentle declivity, as far as may be thought necessary to give drying room for all the wool that may at any time require drying.

This platform, you will, of course, surround with bulwarks to prevent the wool blowing away, and in some situations and cases it may be necessary to have a small house at the lower end of it, to receive the dryed wool on the coming up of a shower, or for storage, &c.

In the case of the Dye-house being erected with a view of running by kettles and the direct application of fire to them, solely, then, as the kettles are to be fired up from the outside of the Dye-house, a low covered building should run the whole length of the fire-place. This is a great convenience and an economical arrangement, especially when fuel is dear, for this building being made wide enough to hold a stock of fuel, prevents it getting wet in bad weather, and avoids the expense of having to burn one-half of the fuel to dry the other half fit for burning.

A door opens out of the Dye-house into the fire-place, and steps, or an inclined plane leads down into it. It may have windows in it, if convenient, and an external door or port-hole, for heaving in and out the fuel, ashes, &c. A ware-house of either one or two stories, for holding the Dyestuffs and keeping them separate and in proper arrangement, must be built right up to the Dye-house; if possible, opening into it by a door. If the nature of the location will not admit of the warehouse being attached to the Dye-house, let it be as near as possible to it, so that the Dyer may lay his hands upon any article that he may want, immediately, and without losing the time most favorable for the Dyestuffs, required to produce the best effects. The Dyer must arrange the internal parts of this building to suit his own convenience. I shall only say, that in it all the articles required in coloring should be concentrated and kept in proper order; and that a small room made off in it, should be used as a laboratory, wherein the Dyer can make experiments and test the qualities of the Dye wares; ascertain the composition of any pattern he may have to color to; make up his compositions; and, in fact, for any thing he may wish to do, with a view of acquiring a thorough knowledge of the principles of his profession, or of making discoveries that may be useful to him as a Dyer, and beneficial to the establishment in which he is employed. If mechanical power can be had in this building, the Indigo and other articles that require it should be ground here; and the form of the mills for this purpose being so various, it is quite likely that each Dyer prefers some one form to another; so I shall give no description of any particular one as preferable to the rest, but shall only express my opinion that for grinding Indigo for the vats, and when lac is ground wet, the common cradle-mill is about the most simple and convenient, and for grinding Indigo dry, the old plan of a pot and balls is as good as any other. Cochineal is generally ground in mills made after the same manner as coffee mills. As to the grinding of other more bulky and less costly Dyestuffs, such as Logwood, &c., it is both cheaper and better to have these done at places where they make a business of it, and where, from practice, they know how to do it in the best possible manner.

The dry-house for winter use should also be attached to, or as near the Dye-house as possible, and so that the wool can be run from one into the other without obstruction. The furnace or stove, with its flues, should be situated below, or underneath the racks or conveniences that you may have for spreading the wool upon, so that the heat may, in its ascent, pass through the wool. If there be two stories, the upper floor will be made of firm slats, just wide enough apart not to allow much of the wool that is spread upon it to drop through. As to any internal conveniences, I leave them to your own particular plan, and shall only observe further, that this building should be made very tight, both in walls, doors, and windows; and the best materials for building it of are brick or stone, of which, indeed, it is best to have all the buildings connected with a Dye-house.

The Wool-house, and also the Card-room, should be as near to, and as much on a level with the Dye-house as circumstances will admit of.

The reader will perceive, after this perusal, that to construct a Dye-house something like what it ought to be, requires as much skill in the contrivance and as liberal an outlay of capital in the execution, as any other part of a woolen establishment. And why should it not? This business is the *main spring* of the woolen manufacture, and if any branch of it requires convenient workshops, apparatus, and skillful and experienced managers, this certainly, of all others, is the one that most demands them; for, on the economy and execution of the colors, depend the reputation and prosperity of the establishment.

THEORY AND PRACTICE OF WOOL SCOURING, WITH A DESCRIPTION OF A VARIETY OF SCOURING LIQUORS, AND THE METHOD OF MAKING THEM.

THE first operation connected with Dyeing, is to divest the wool of a greasy or fatty matter which envelops the fibre; which operation is performed as follows: A kettle holding about 150 gallons of liquor is a convenient size for scouring from 20 to 25 pounds of wool at a time, but a vessel of any other dimensions will answer. To commence with setting a fresh *scour*, you have to fill this kettle two-thirds with water, and the other third with stale urine. Raise the temperature of it to 140 deg. Fahrenheit; enter the above quantity of wool, (20 pounds if fine, and 25 pounds if of coarse quality;) work it well with the stick, so as to have every fibre exposed to the action of the liquor, and after about ten minutes' immersion, heave it on to the scray to drain; then enter another similar quantity, and proceed as before; take this out and enter a third quantity; heave out and drain this a short time, then throw it into the wash-box and commence rinsing. The two former kettles full, now return into the liquor again, so that the one which was steeped the first may go into the kettle after the other two. The reason for thus returning the two first scourings into the kettle again before rinsing, is because the scour liquor is not in a fit state to dissolve or render soluble the fatty substance adhering to the wool, until after the third or fourth scour; in other words, there requires to be formed a species of ammonical soap-liquor before the grease becomes sufficiently loosened to wash clean and effectually from the wool. Rinse these two scourings in succession after the first, and proceed, *secundum artem*, to scour and rinse kettle after kettle-full. About three times running off and on the water is sufficient to rinse it, but whether more or less is required, take care to have all the suds effectually washed out of the wool, which is known by the last box-full of water being clear and free from any soapy appearance; then throw out the wool to drain. If it be properly cleaned it will exhibit the following characteristics: it will drain quickly, and as the water leaves it, begin to spring and swell gently up; it will look bright and white, and have a glistening appearance when seen by transmitted light; on taking it up in the hands it feels light and lofty; on shaking it over, it readily parts asunder, falling lightly and feather-like; it leaves no stickiness upon the hands, and it smells sweet, having no scent of the sheep or grease about it. On the contrary, if the wool be badly scoured, or set in the grease, while it is yet in the wash-box, it will cling together more heavily and feel weighty on the stick; on throwing it out, it dries slowly; it clings together and cannot be separated; it is clammy and greases the hands; it is yellow and dirty looking, and the most casual observer will perceive that there has been some improper management of it; it will have to be rescoured.

If, by any accident, you should happen to have a scour of this description, the best plan you can take with it is to make a solution of soap in clean water at 170 deg. and pour in a little olive oil; work it in this five or ten minutes; then wash out. You will do well now to look to your scour-kettle, to prevent a like recurrence.

As the scour-liquor by use gets thicker and acquires more consistence, it will start the grease quicker and better, and by the second or third day after setting will be in as good condition as it ever will be. Our care, therefore, ought to be to preserve it in this solution all the time (for a scour may be used for a year together without having to set afresh, if common prudence be employed in its management.) In order to secure this object, every morning, before commencing work, take care to skim off all the thick scum that rises to the top during its repose through the night, and scoop out from the bottom (by a hollow shovel made for the purpose) all the sand and earthy matter that settles there, the wool always containing more or less of it. If, after the scour has been set some time, it should get unnecessarily thick, heave out some of the liquor and replenish with water and rather more urine than usual; it will scour better after this renovation than before. I would observe here that we should so adjust the body of the scour as to be thick enough to start the grease easily, and yet not leave it so thick as to require an unnecessary quantity of water to carry off all the suds. This state is best represented on the second or third day after it is set.

It is a common, nay, I may say, a universal practice among dyers, not to be so particular in scouring the wool for kettle-colors, as for blue-dyeing. This arises from false ideas, and I see no reason whatever for such a distinction; on the contrary, I press it forcibly upon the attention, both of manufacturers and dyers, that for all colors whatever, the wool can never be got too clean. I will illustrate this a little:

Suppose the grease not to have been sufficiently started in the scour-kettle; in this case, all the water in the world will not free that wool from the grease thus set, (or fixed,) and you find that it handles greasy and sticky to the fingers. We proceed to dye it of some common color—say black, olive, drab, &c. It is true that the color will appear tolerably well; but let us follow it through the processes of manufacturing, and trace out its final results.

In the first place, this wool will be found to card badly, and require more oil than clean wool, in order to overcome the resistance exhibited by the adhesiveness of the greasy paste left upon it previous to coloring; it makes also considerable more dirt and waste than ordinarily, which becomes a serious loss, if long contined; it spins badly, breaking, and not drawing out or making as fine, even or strong yarn as it otherwise would do; it does not weave so well either. But it is in the subsequent operations of scouring and finishing that we are to look for its worst effects; for the flannels can scarcely ever be scoured clean; and if they should be, it is only to be done by repeated scouring and drying, or by the employment of a scour-liquor of such excessive alkaline strength, as not only to injure the texture, and fulling property of the cloth, but almost to destroy the color, which will look dull, lifeless, and poor; the cloth itself will have a dead, lusterless appearance, and it is utterly impossible ever to get that high steam polish upon the goods which constitutes the chief excellence and beauty of modern improvements in finishing. The consequence is, such goods go to market and sustain a loss proportionate to the above defects in their manufacture.

Like results follow, when, after fairly starting the grease, (in the scour-kettle,) we neglect to wash out all the suds; for in the process of dyeing, the metallic or earthy salts, such as sulphate of iron, sulphate of copper, alum, &c., enter into combination with the soapy matter left in the wool, the acids of such salts uniting with the alkali of that soap, and the metallic or earthy base combining with the grease, forms, by this double decomposition, a mineral soap perfectly insoluble, and which can never be separated from the fabric by any other process whatever.

This will suffice (without naming other disadvantages) to show the absolute necessity of having the wool properly cleansed, even for the most common shades, and the dyer will perceive how essential it is to his interest to have a perfectly clear ground on which to place his colors; for on clean wool the colors take easily, look bright, and are permanently fixed, and every subsequent process of manufacturing has a tendency to improve the beauty and lustre of the colors and the fabric.

It is true that wool can be colored in a permanent manner (by a peculiar process) without any scouring at all; and I have frequently colored thousands of pounds in that state, and it works in every respect well, with the single exception of making dirty work for the carder; it spins better, and the flannels scour even easier than if the wool had been previously scoured. But in this case the fatty or oily matter is in a free state, and no alkali being combined with it, the mordants employed in dyeing cannot be decomposed by it, any more than they can with clear oil, when it is poured into a solution of any metallic salt in water. It is only when this unctious matter is in union with an alkali that an insoluble soap is formed, as I described in detailing the effects of bad scouring.

But, in order to exhibit these effects in a more tangible and lucid manner, let us proceed to an experiment.

Make a clear solution of alum, or sulphate of Iron, or any other metallic salt; take a part of this solution and pour some oil into it; now, observe, the oil rises to the surface, no action taking place between it and the mordant in solution. This experiment represents the case of dyeing the unscoured wool.

Again—make a clear solution of common soap; pour this into the remaining clear solution of alum, sulphate of iron, &c. Now it is that you may observe distinctly the results of chemical action and the power of double affinity; the clear liquors, upon their mixture, instantly becoming turbid, muddy and broken. Continue to watch this and you find that a flocky, curd-like precipitate will fall to the bottom of your vessel, and the supernatant liquor will remain clear.

This liquor, by analysis, is found to contain a neutral alkaline salt (composed of the acid of the alum, &c., and the alkali of the soap;) on examining the curd-like precipitate, we find it adhesive and sticky to the fingers, and if we pour it into fresh water and boil it ever so much, it will still fall to the bottom upon being suffered to settle a while, showing by this its perfect insolubility in water.

This insoluble substance is a mineral soap, which has been produced when the two solutions were mixed, by the earthy or metallic base of the mordant uniting with the grease of the solution of soap; and this it is, that in the process of dyeing wool which has been badly scoured, attaches itself to the fibres and can never afterwards be removed.

It follows, from these observations, that it is better to color the wool in its natural state, than attempt to scour it and not perform that process thoroughly. Half work is no work at all.

I may appear to have been rather prolix on this subject, but I think I have said no more than its importance requires; and I again repeat, it will do well for us to see that, in commencing this preparatory step to dyeing, we be certain to begin right, making a clear foundation, and leaving nothing that can afford resistance to the free action of the dyestuffs upon the wool; for upon the mutual and intimate combination of these, depend the beauty and permanence of our colors.

Having thus shown the importance, and laid before you in theory and practice, the process of scouring wool effectually, I shall conclude this article by describing a few composition liquors that may be used as a substitute for urine, in situations where that cannot readily be obtained:

SUBSTITUTES FOR URINE.

1st.—Water of Ammonia (or Spirits of Hartshorn;) give from 1 to 2 quarts per cwt. of wool.

2d.—Muriate of Ammonia and soda in equal parts; give one-fourth of a lb. each to 1 cwt. of wool.

3d.—Dissolve 20 lbs. of pearl ash in 32 gallons of water; add 4 lbs sulphuric acid, then one gallon of olive oil: mix well together; use one quart of this to every 1 cwt. of wool.

4th.—Dissolve 12 lbs. of soda in 32 gallons of water, then add 6 gallons of potash soap; incorporate well by stirring, and give about a quart of this to each cwt. of wool.

None of the quantities here mentioned to be given to the wool at a time are definite, because some of the wools require more and some less scouring matter than others. In scouring wool we have to be guided by circumstances, as to the quantity of alkaline matter necessary to be given at any particular time; but we should always keep in mind that the less quantity of alkali we employ in scouring, so *that* be effectually performed, the better it is for the wool.

And it must be borne in mind, too, that the above recipes are not given with a view of abolishing the use of urine, but only as *make-shifts* when that cannot possibly be obtained; for I wish to impress it upon the memory that urine is the best and only *natural* scour for wool or for woolen fabrics, and nothing ever leaves the article in so good a state as stale urine. The first two substances come the nearest to it in effect; but always employ urine about woolen goods in preference to anything else.

DESCRIPTION OF THE MANUAL OPERATIONS RE-QUIRED IN DYEING WOOL—KETTLE COLORS.

After scouring the wool, as detailed under its proper head, and allowing it to drain equally and well until the next day, commence handling it as follows:

Shake the wool down in front of the kettle, breaking out all the flakes and lightening up the whole pile; opening it in such a manner as to separate all the twisted and hard lumps, so that the whole may lay loose and buoyant, which will cause it to imbibe the color equally and evenly on being thrown into the kettle.

When you have shook over the wool, run up the kettle with water to a proper working height. This will check the boiling, and you can enter the wool more easily, and it will give it a better chance of coloring in an even manner.

Then take out the bags (if you have a color that requires them in,) and always bear in mind to rake up the kettle well, before entering the wool.

These preliminaries being concluded, let the wool be thrown in, expeditiously and loosely, giving it all the chance possible for every part to receive an equal share of the coloring matter; get the whole under the liquor as quick as the workmen can accomplish it, without appearing to be in a *flutter;* sweep up all the scattered locks and make the floor tidy.

Now, let your hands take the levers or dye-poles and raise and shake the wool well over with these, until you perceive the color to have taken on every portion of it alike; then press the whole under the liquor.

This operation lasts from fifteen to thirty minutes, according to the size of the kettle and quantity of wool to be dyed.

Get on a boil as quick as possible, and continue this at a brisk and steady rate for two hours, with an occasional putting in a lever, to aid the boil in changing the position of the wool, if that be required.

This time being expired, you will prepare to *sadden* by running the kettle up with water and stopping the boil; then heave in the levers, and while the men are working this as before, throw on your mordant or sadden in such a manner that by the time the whole of this is expended, the wool may be evenly imbued with it. This takes up about as much time as the first breaking-up. Now press the whole under the liquor, and get on a stiff boil, which continue at a brisk and steady rate for one hour; then draw off your fire or steam; run the kettle to the brim with water, and let all remain in during the night, excepting such cases as are expressly specified to the contrary in the recipe for producing them.

Some dyers, on *saddening*, take out about half the wool upon a *scray* placed over the kettle, throwing it into the liquor again gradually, adding portions of mordant as they get in more wool; and when all is re-entered they give the whole a good stirring with the levers.

I seldom or ever take this course myself, considering it useless to adopt such a plan, except where the kettles are crowded excessively with wool, which I take care always to avoid. Notwithstanding this, for some very light colors, and such as *sadden* evenly with great difficulty, you may take this method if you think proper.

For preparation colors, once using the lever on entering is sufficient with two hour's boiling, and for finishing the same off, in a fresh liquor, once handling over and one hour's boiling is all that is necessary.

For such colors as are dyed off at one operation, a good use of the levers on commencing, and an occasional turn of the wool in the kettle, with one hour's boil, is all that is required to complete them.

This method of handling the wool is the mode to be pursued in dyeing any or all the kettle colors, laid down in this work; and I have made this description of it the subject of a separate article, in order to avoid a ceaseless repetition with every prescription for producing each separate color.

ON THE TREATMENT OF THE DYESTUFFS IN THE KETTLE; OR THE PREPARATION OF THE DYEING LIQUORS.

THE dyestuffs, as a general thing, are either in a ground or chipped state; and as the economy of dyeing depends somewhat on the treatment which these receive, in order to extract all the coloring matter they contain, I shall give a brief account of the means to do this in the most expeditious and effectual manner.

In the first place, always see when your kettle has been emptied, that there be no remains of the former dye left in it; but always make sure of having a fresh batch of clean water, as any portion of the metallic salts, alum, &c., have a tendency to prevent the extraction of the coloring principle from the dyestuffs; but more especially from camwood, barwood, and all the hard resinous woods, which refuse giving out all their color when ever so little of these salts are in solution in the liquor.

Next, provide yourself with some coarse bagging; hair bagging is the best and most durable, if you can obtain it. In these bags you must boil all your chipped dyewoods, taking care not to put too much into them, or to have them too closely tied, but to leave space enough for the enclosed chips to shift their position by the boil, or the shaking up which you occasionally give them.

If you are making a liquor that requires nothing but chipped dyestuffs, you will suspend the bags containing these by stout strings from a stick laid across the kettle, and boil them one and a half or two hours; then take them out before entering the wool.

If you have a color requiring nothing but ground dyestuffs, boil all these in a small suitable vessel and take this clear solution for use in your dyeing kettle; but if you have not this convenience, then throw them into the kettle loose, and boil well from thirty minutes to an hour; the hard resinous woods, such as camwood, &c., require considerable length of boiling to extract their color, while the other, such as logwood, readily part with it to boiling water.

Fustic requires a longer time than logwood. Ground dyestuffs ought never to be boiled alone in bags; because, lying solid and compact in them, you can never get a sufficiency of water round it, to bring the coloring matter into solution.

If you want to form a liquor wherein both ground and chipped dyestuffs have to be used, first mix the chips and ground dyestuffs together before putting them into the bags, and boil them about two hours before entering the wool.

By boiling the ground dyestuffs with the chipped, you will find it takes more of the former than when they are boiled separately, but you have the advantage of your wool being clean and free from dust.

Some dyers, after boiling up the chips and taking out the bags, enter the wool, and as this goes in, they sprinkle on the ground dyestuffs in layers, until the whole be given to it. You can take which course you like best, but I prefer the boiling previous to entering the wool. But the right plan is never to have any loose dyestuffs in the kettle, as it gets among the wool, and shows a slovenly way of coloring. Let the dyeing liquors, in all cases, be clear solutions of the coloring matter of the dyestuffs, viz: limpid, aqueous tinctures of the coloring principle only.

Again, if you have a color that is to be finished off at one operation, or where you have to mingle both the coloring matter and the mordant together, first boil out the dyestuffs as above, and then throw in the chemical salts which form the mordant, and boil these until all be dissolved; then heave in the wool.

Lastly, in preparation colors, where very little, besides the chemical salts employed as the mordant, is used, all you have to do is to throw these into the kettle and boil well up for about half an hour, then enter the wool.

To conulude; you will take care always to rake up the kettle well, before entering the wool.

As there are no rules without some exceptions, any variation from this general plan, you will either find stated in the recipe of the color requiring it, or it will be found by referring to my account of the dyestuffs.

I have made a distinct article of this account, so that I might not have to repeat it continually with the prescription for each separate color.

ON THE DIFFERENT MODES OR PROCESSES OF DYEING.

THERE are but three general methods or processes of Dyeing wool or woolen goods; or, in other words, distinct plans of combining colors in a chemical manner with animal fibres. I shall attempt to give an account of them, with an explanation of the theory upon which these combinations take place.

The first I shall describe, is that process wherein all the materials that enter into the composition of the color, are mingled together in one common liquor or bath, and applied to the wool at once, by about one or one and a half hour's boiling.

FIRST PROCESS.

If into a clear solution of logwood, fustic, or other kind of Dye stuff, you pour another solution of any metallic or earthy salt, as sulphate of iron, alum, &c., you will observe when this mixture takes place, the liquor becomes *broken*, and a flocky or curd-like matter is formed, which gradually settles to the bottom of the vessel in which the mixture was made. This precipitate is the color; which in this first mode of Dyeing you apply directly to the wool by about one and a half hour's immersion and boil.

This experiment exhibits in the clearest manner, the formation of any color we wish to combine with the wool; actually impressing on the visual organs the mysterious operations of the invisible mechanism of Dyeing; for we really and positively *see* the union take place between the coloring principle and the earthy or metallic salt; the combination of which two substances forms or makes the color we intend to apply to the wool.

It also explains the true theory of the formation and constitution of colors, showing them to be a chemical compound, the elements of whose composition are an undefined coloring principle, distributed abundantly through the vegetable and mineral kingdoms, and an earthy substance, or metallic oxyde.

Although this flocky substance (which is the new-formed color) gradually subsides to the bottom, and leaves the liquor but slightly tinged, yet it is not an insoluble precipitate, but is partially soluble in water, and more particularly at a boiling heat; and on this slight degree of solubility hangs the property it possesses of forming a chemical union with the wool. Did it form an insoluble precipitate, no chemical combination could take place by this mode of Dyeing; because the wool (or cloth) being boiled in a liquor containing nothing but an insoluble powder, no chemical action could take place between them, and the wool would be merely *stained;* and this insoluble precipitate only adhering to it, and that with but a slight mechanical force, the simple operation of washing in water would be sufficient to remove it.

As said before, this partial solubility of the color is the cause of its union with the wool; for on immersing the latter in the liquor, it immediately seizes the part held in solution (the affinity between the color and wool being greater than between the water and the color;) the water thus robbed of what it held in solution, now dissolves another portion of the color, which is again taken up by the wool; and so on, portion after portion, until the whole becomes fairly combined with the wool, having all been dissolved successively by the water, before it could enter into a close and intimate combination with the animal fibre.

This mode of Dyeing requires a rapid ebullition during the time of coloring, as the greater the heat and agitation given to the water, the more finely are the broad flocky particles broken and cut up; and in proportion to the minuteness of the coloring molecules, so will be the intensity of the shade.

Although this method of Dyeing be more expeditious than either of the other two, yet I do not consider it equal to them, either in brilliancy or permanency of color.

This plan is more generally used for coloring yarn, flannels and cloth, especially the finer colors; but you will find it resorted to in several of the recipes in wool Dyeing.

SECOND PROCESS.

The second mode of applying the color is known among Dyers by the appropriate terms of *Stuffing* and *Saddening*, and its operations are performed in this manner:

After the Dyestuffs have been sufficiently boiled to extract all their coloring matter, the wool is entered and two or two and a half hours' boiling given to it. This is the *stuffing* part of the process; and the wool only receives in it the slight tinge of color peculiar to an extract of the Dyestuffs used in making the liquor.

Longer boiling than the above time is needless, as all the color necessary to produce the best effect is, in that time, combined in the wool.

The next stage is the *saddening*, or giving to it the Mordant, which consists of some chemical salt, such as sulphate of iron, sulphate of copper, alum, &c.; the manner of doing which is laid down in the article "on the Operations of Dyeing."

In the first part of this process, a combination is effected between the wool and the coloring matter, analagous to that which takes place between the astringent, or tannin-principle, and the raw hide in the process of tanning. Let us illustrate this a little.

Make a decoction of any of the Dyestuffs—logwood or fustic, for instance—then pour into this decoction a weak solution of gelatine, and you will perceive that a precipitate falls, of the color of the solution of the dyestuffs employed, and a great quantity of color has been abstracted from the decoction. This precipitate is the glue and the coloring-matter, which, by their mutual affinities, have formed a compound that is insoluble in water. Of a similar nature is the union resulting from the boiling of wool in the solution of most of the Dyestuffs.

In the *saddening* part of the process, both the coloring matter and the wool having a strong affinity for the metallic or earthy salts, these are drawn by them with an increased attraction, and a triple compound of animal matter; the coloring principle; and the mineral base of the color is formed; which being held together by virtue of the three separate forces, offers such a resistance that boiling water cannot disunite them.

Precisely similar are all unions of coloring matter with wool, no matter what process may have been employed to effect it.

THIRD PROCESS; OR PREPARATION AND FINISHING.

This is exactly the reverse of the second mode, and consists of two distinct stages; in the first of which the wool is boiled for two or two and a half hours (and suffered to remain all night) in a solution of the metallic or earthy salts that form the Mordant or base of the color you wish to produce. These have a strong tendency to unite with the wool; inasmuch that on coming out of the preparation it is in general tinged with the shade peculiar to the oxyde of the metal used; and so tenacious is its power of adhesion, that after the coloring matter originally used shall have faded off, or undergone a material change, the property of the Mordant remains unaltered, for it will absorb fresh coloring matter as readily as before.

After coming out of the preparation it is customary to wash the wool.

In the second part of this process, a bath of clean water is prepared, in which the Dyestuffs are boiled till all the color be extracted; in this the Mordanted wool is dyed up, occupying about one or one and a half hour's time in boiling. In this case, the wool and the Mordant both having an affinity for the coloring matter, their joint forces attract it from the water with such impetuosity that it is immediately and rapidly united with them, and the color is soon brought out. For this reason, the finishing part of the process requires expert workmanship in order to have the wool evenly dyed.

The same colors, Dyed by this process, are more superb and permanent than by either of the other plans; but this method requires more time and labor, and is also more expensive than either of the other modes.

ON THE HEIGHTENING OF COLORS.

This operation cannot be considered a distinct process, but only a continuation or additional part of any of the above processes, and is generally performed either in a clean liquor, or a portion of the Dyeing bath is run off and fresh water added to the remainder to bring it to the proper temperature. The articles used for this purpose, or as alterants to the shade, are commonly either alkalies or acids.

The raising of Pinks and Crimsons, and the raising of Prussian Blue by alkalies, and the heightening and stripping of Cloth Dyed Blacks (that are rusty or foxy) by acids, are a few examples of colors requiring this extra operation to produce the shade sought for. (The temperature in these cases is about 125 deg.)

From these observations, it will appear plain that there can only be three plans of combining colors with wool:

1st—By applying the whole color at one operation.

2d.—By combining the coloring matter with the wool, and then giving it the Mordant.

3d.—In fixing the Mordant on the wool first, and then applying the coloring matter afterwards.

OBSERVATIONS REGARDING A SYSTEM OF COLORS.

Without a System, no art can be readily acquired, or easily practised, however simple. How much more complicated and difficult to learn must one be, which is made up of such a diversity of perceptible differences as the whole range of colors embrace!

The art of Dyeing, or the making of Artificial Colors, has long labored under the disadvantage of having no regular classification of parts or knowledge of principles annexed to any description of the colors that form the subjects of it. To free it from this perplexity, with a view of making its study more easy and pleasant, by ascertaining whether or not there is any system belonging to it, is what I pledged myself in the commencement of this work to perform; and with this end in view, we will begin our inquiries in those departments of Nature and Art most likely to furnish matter of observation from which we may arrive at a sound conclusion.

If we cast our eye over the field of Nature, when the genial heat of the summer's sun has brought to perfection every portion of the vegetable world, and has tinted every leaf, every blade of grass, every flower, with colors of exquisite beauty, and of such a numberless variety of hues and shades, it seems to us as though a profusion of delights were scattered around us in every direction, in disorder and confusion, and that no system or arrangement could in any way be connected with this infinity of tints and dyes.

If we visit the crowded city of ever-busy, ever-active man, we observe the multitude on the holidays or festal-times, decorated with all the gorgeous colors that art can produce: and here it seems impossible, amidst such a variety, to distinguish anything resembling a system full of order and beauty, which by its arrangements regulates the combinations of the elementary hues that produce such a multitude of shades.

Again, if we examine any of the writings of the Dyers on the subject of making Artificial Colors, these serve only to render the confusion more confused, and there appears nothing but a chaos of colors without elements, without parts, and without arrangement, and totally devoid of connection between principles and combinations; causes and effects.

It is to clear up this confusion—to sort out and append in their proper places and positions, (the different parts that compose this pleasing disorder,) with a view of ascertaining whether there really is a natural system connected with it or not, that I shall attempt the task of explaining to the reader the method of finding out its primary rays, and the manner in which these unite to form the several Classes, Orders, and Species of its variegated whole.

Although we fail in all these fields of investigation to discover, by a general and promiscuous examination, anything like system or order in the variety of colors presented to our view, yet upon calm reflection we are induced to believe that the All-wise Contriver, in ordaining this department of His handiwork for the glory and ornament of the rest, wrought not without design, nor left it devoid of evidence that His skill had appointed its arrangements, and His wisdom perfected its plans; that He gave to it harmonious parts and created a system, composed of a few elements, whose transformations are sufficient to make all that charming variety which at once satisfies the eye and delights the soul.

That such is really the fact, the Dyer, in the daily pursuit of his profession, has opportunities of proving experimentally; and on the strength of this experience we shall endeavor to point out the elements of it, and show that these and their different combinations form the Classes, Orders and Species of a System as perfect in its parts as that which distinguishes the numberless varieties of vegetable productions.

We will now put it to the test of experience and practice, by which every Dyer and *painter* will know that they cannot produce a Yellow, a Red, or a Blue, by mixing any two or more colors together: consequently these must be Simple and undecomposed, Primary, or Elementary Colors; and if we show that we can make every other color, by the union of any two or more of these first principles, we shall prove that these three are the only simple colors, or the Elements or ultimate parts that compose all the rest, and constitute the three Orders of the First or Primary Class in this System.

Having now ascertained that there are three distinct First Principles, let us see what the results of their mutual action upon each other will produce.

By taking the Yellow and the Red, we obtain Aurora; by mixing the Red and the Blue, the effect is Violet; and from the union of the Blue and the Yellow, results a Green.

Thus, the simple action of any two of the First or Original Colors, gives rise to a separate Order of another Class, which we shall call the Secondary or Compound Class of Colors.

But we perceive there is another range of Colors that are much darker and heavier than any that are included in the two preceding Classes, that we have yet to account for; and we wish to ascertain whether these are derived from the same source, or whether there be not some other Primitive Colors that we have overlooked. To determine this, we will try what a mixture of the three Elementary Colors, added respectively to each of the Orders of the Compound Colors, will produce.

Thus: Aurora, to the Yellow, Red, and Blue, will give us a Brown; Violet, Yellow, and Blue, will afford a Plum or Corbeau; Green, with the Yellow, Red, and Blue, produces the Olive.

This experiment convinces us that, from the three original colors, by a triple union, only differing in the quantity of their proportions, we can produce a third and distinct Class, which may be named the Tertiary or Triple Class of Colors.

There can now remain but one other method of assimilation that these colors may assume, and that is by uniting with the Primary Colors all the products resulting from the different ways in which these have combined; and this will give us a mass of colors, the effect of whose union form the shades of Black, which we may term an Aggregate Class of the whole.

Thus, by experience—which is the true test of every theory—we have proved that there exist only three Primitive or Simple Colors, from whose transformations flow three other Classes, the species and varieties of which include every description of tint and shade under the whole heaven.

These facts go to show the existence of a natural arrangement of the different combinations of the Elementary Colors, and incontrovertibly prove that it is not a creation of yesterday, or a mere hypothesis of my imagination, but that it is a splendid system whose Maker and Framer is God; that it dates its existence from that epoch of eternity when chaos felt the voice of the Omnipotent, commanding "Let there be light," and straightway light, with all its colored rays, burst into being, and He named that day. Yes, it displayed its glorious splendors with that first moment of Time, when the primeval darkness fled away; when the shapeless void became full of beauty and order; at which the morning stars sang together, and all the sons of God shouted for joy.

To make the foregoing statement more plain and intelligible, I will give a table of Classes and Orders, with the colors that enter into their composition.

A TABLE OF THE CLASSES AND ORDERS, WITH THE COLORS THAT ENTER INTO THEIR COMPOSITION.

	CLASSES.	ORDERS.	COMPOSITION RAYS.
Prismatic Division.	Primary.	Yellow. Red. Blue.	Simple. Simple. Simple.
	Secondary.	Aurora. Violet. Green.	1 Yellow and 1 Red. 1 Red and 1 Blue. 1 Blue and Yellow.
	Intermedial.	Bronze.	1 Yellow, 1 Red, 1 Blue.
Non-Prismatic Division.	Tertiary.	Brown. Plum. Olive.	2 Yellow, 2 Red, 1 Blue. 2 Red, 2 Blue, 1 Yellow. 2 Blue, 2 Yellow, 1 Red.
	Aggregate.	Black.	3 Yellow, 3 Red, 3 Blue. All the Colors.

The foregoing Table must be substantially correct, being founded upon natural distinctions, or union of rays of color; but on entering upon the details of the minuter subdivisions of the plan, by attempting to describe what may be supposed its species and varieties, I do not expect to arrive at such positive conclusions as when tracing the more prominent features of the scheme; because in doing this so as to answer the practical purposes of dyeing, or making of artificial colors, I shall be obliged to resort to artificial distinctions, and to make the basis of the varieties, in some instances, depend upon the kind of dyestuffs now used for producing them; and the species to consist of the different shades which a greater or less quantity, or any difference in the proportions of those dyestuffs, produce.

I perceive and acknowledge the deficiency and imperfection of deriving any of the Species and Varieties from such a source, but until we can obtain the coloring principle, (giving the primary hues) in a state of purity, I do not, with my present views, see how we can derive them from any other data that will answer the practical ends of the art so well.

That there is a natural division of the different Orders into correct and distinct Species and Varieties, (in all cases,) founded upon equivalent proportions of combining ratios, I have not the least doubt. But I have neither the time or the means at my disposal at present to carry on any further, the investigation of this interesting subject; yet I do hope, that if I should be debarred the pleasure of again prosecuting this inquiry, some one with more means and greater abilities than myself, will enter into an examination of it; correct my errors, and exhibit a perfect plan, complete in all its details.

Although, as I said before, I am not perfectly satisfied with the foundation on which I have based some of the species and varieties, yet I believe it better adapted to the present practice of dyeing than one would be that is drawn from the natural divisions, resulting from the difference made by the quantities of primes of any color over the other.

Though these details may appear objectionable to some, and not entirely satisfactory to myself, yet in drafting this sketch of a system, I consider that I have fulfilled my promise in the Introduction to this work, viz.: "An Attempt at Systemization;" and my object will be answered, if others, perceiving my defects, will, with more powerful minds and ampler means in their possession, rectify what may be wrong, and build up a perfect whole.

Such, then, as the System appears, according to the foregoing description, I will expose in a tabular form, in its Classes, with their respective Orders, Species, Varieties and Component parts, or elements of constitution, so that when thus laid bare, it may be easy to detect any errors which may be supposed to exist in it.

PRIMARY CLASS OF COLORS.

ORDERS.	SPECIES.	VARIETIES.	CONSTITUENT PRINCIPLES, OR ELEMENTS OF CONSTITUTION.
Yellow.	Lemon and Gold.	Bark, Weld, Fustic, &c.	Simple and Undecomposable.
Red.	Rose, Scarlet, Com'n Red.	Cochineal, Lac, Madder,	do. do.
Blue.	Indigo, Royal, Logwood.	Indigo, Logwood, Prussiate.	do. do.

SECONDARY CLASS OF COLORS.

Aurora.	Orange and Nasturtion.	Cochineal, Lac, Madder.	1 Yellow and 1 Red.
Violet.	Lilac and Purple.	Indigo, Cochineal, Logwood.	1 Red and 1 Blue.
Green.	Apple, True Green, Laurel.	Indigo, Logwood, Sulp. Indigo	1 Blue and 1 Yellow.

INTERMEDIAL CLASS OF COLORS.

Bronze.	Simple.	Indigo, Logwood.	1 Yellow, 1 Red and 1 Blue.

TERTIARY CLASS OF COLORS.

Brown.	Pure B., Red B., Yellow B.	Chrome, Spirit, Sulphate Iron.	2 Aurora and 3 Bronze.
Plum.	Pure P., Brown P., Blue P.	Logwood, Camwood, Indigo.	2 Violet and 3 Bronze.
Olive.	Pure O., Brown O., Green O.	Chrome, Common, Indigo.	2 Green and 3 Bronze.

AGGREGATE CLASS OF COLORS.

Black.	**Slate, B. Black, Jet Black.**	**Fast and Common. Indigo and Logwood.**	**All the Colors.**

On a careful survey of this Table, it will be seen that I have deduced the Species from the common names in use, or from the peculiar shades or inclinations of the colors towards some other color, and the Varieties from the different kinds of materials from which we obtain the coloring matters.

This seems a more natural mode of ascertaining the Species and Varieties than the method I intended at first to act upon, and may answer the purpose of the Dyer, and even the painter, full as well, and undoubtedly agree better with the natural subdivisions of colors; but we cannot avoid seeing that both the Species and Varieties, as here obtained, are mere arbitrary distinctions, especially the Species, and have very little foundation in natural differences, or derivation.

In completing this arrangement, I have only now to show the quantities in which the elementary colors unite with each other to form all the other colors; or what proportion they bear to each other in any individual color, the result of their union.

This exposition may be of considerable practical service to the Dyer, who may carefully examine and study it, as by a reference to it he may ascertain what proportion of the Simple Colors, and how many of them, exist in any pattern he may have to Dye to.

For instance, we wish to color a pure Olive: this color, according to the table, belongs to the Tertiary Class of Colors, Order Olive, and is composed of Bronze and Green. We want to see, in the first place, how many of the Simple Colors it takes to make Olive.

We find that in the composition of Bronze there is one part, proportion or prime of Yellow, another of Red, and another of Blue: or the three Simple Colors are all united in equal parts or proportions to form the Bronze.

Then by the same table we perceive that Green belongs to the Compound or Secondary Class, and is made up of equal proportions of Blue and Yellow.

Thus, then, there are five proportions or primes of color in Olive; three of these are in the Bronze and two in the Green; and the kind and quantity may be thus shown:

$$\left.\begin{array}{l}\text{1 Yellow}+\text{1 Red}+\text{1 Blue}=\text{Bronze.}\\ \text{1 Yellow}+\text{1 Blue}=\text{Green.}\end{array}\right\}=\text{Olive.}$$

Or, taking the proportions in the Bronze and Green, we have it: 2 Yellow+1 Red+2 Blue=5 primes or proportions of color in Olive.

Therefore, 5 is the prime equivalent of Olive, and so with every other color.

Then to reduce this to practice: suppose we have 10 lbs. of wool to color a pure or positive Olive, and we think to Dye it with 5 lbs. of Dyestuffs, two parts of this must be such as will produce Yellow, two parts Blue, and one part Red.

Naming the kind of Dyestuffs, we say, for 10 lbs. of Wool take 2 lbs. of Fustic, 2 lbs. Logwood, 1 lb. Madder, (with the saddening,) and we should certainly obtain a first-rate natural Olive. Yet, it must be borne in mind, that in speaking of these primes of colors, we have in view only the pure color, and not the rough Dyestuffs, from which the coloring principle is obtained; because 1 lb. of Fustic, 1 lb. of Logwood and 1 lb. of Madder do not each produce a like quantity or weight of pure color. I will give an extreme case:

For example—1 lb. of Indigo, we will say, dyes 20 lbs. of wool of a certain depth of color that will take 4 lbs. of Logwood and its Mordants to produce the same appearance; and so in regard to the other Dyestuffs.

Therefore, in coloring, by calculating from primes, the Dyer must form some idea what quantity or proportion of pure color he supposes each kind of rough Dyestuff to contain, in comparison with the other; nevertheless, he will ever come very near certain and positive results, by taking as many parts (in proportion to each other) of the common kinds of Dyestuffs as there are prime proportions in the color he is about to Dye.

Having said thus much, I will give an arrangement of the natural Colors, Combinations, or Orders, with the proportions or parts that enter into their composition, and leave it to elucidate itself.

ATOMIC THEORY OF COLORS; OR THE PRIME EQUIVALENTS OF COMBINING RATIOS:

Otherwise, the Kinds and Proportional Quantities of the Simple, or Elementary Colors which enter into the Constitution of the Derivative Colors.

CLASSES.	ORDERS.	PROPORTION OF COMBINATION.	REMARKS.	PRIME EQUIVA.
Primary.	Yellow.	1 Pure Color.	Simple.	1 Equivalent.
	Red.	1 do. do.	do.	1 do.
	Blue.	1 do. do.	do.	1 do.
Secondary.	Aurora.	1 Yellow, 1 Red.	Compound.	2 Equivalents.
	Violet.	1 Red, 1 Blue.	do.	2 do.
	Green.	1 Blue, 1 Yellow.	do.	2 do.
Intermedial.	Bronze.	1 Yellow, 1 Red, 1 Blue.	Triple.	3 Equivalents.
Tertiary.	Brown.	1 Bronze, 1 Orange.	2 Yellow, 2 Red, 1 Blue.	5 Equivalents.
	Plum.	1 Bronze, 1 Violet.	2 Red, 2 Blue, 1 Yellow.	5 do.
	Olive.	1 Bronze, 1 Green.	2 Blue, 2 Yellow, 1 Red.	5 do.
Aggregate.	Black.	3 Yellow, 3 Red, 3 Blue.	All the Colors.	9 Equivalents.

EXTREMES AND MEAN OF THE SYSTEM:

White.	Bronze.	Black.
0	3	9

This System of Colors is not confined to Woolen-Dyeing alone, but applies to the coloring of every other kind of Fabric; and to Coloring substances and Colors in general. In Dyeing, White is the *absence*, and Black the *presence* of all Colors.

EXPLANATION OF THE RECIPES OR PRESCRIPTIONS.

The following recipes are all arranged in a regular and systematic manner, in Classes, Orders, Species, and Varieties. The utility of such an arrangement will be obvious at first sight; for by this method the young Dyer (for whose benefit I have compiled this work,) will be able in a moment to find the recipe of any color he wants, and the same instant ascertain to what Class, Order, and Species it belongs, and whether it be a Simple or Elementary color; a compound of two of the Primary colors; a *triat* of them; or an Aggregate of the whole.

I have begun this arrangement with the Primary Class of Colors, continuing it through the Secondary, Tertiary, and Aggregate Classes, commencing uniformly with the lightest shade of each Order, and defining its different Species, by one, two, or more varieties, until I arrive at the deepest shade ot that Order.

I have started the series at the palest shade of Yellow, considering that point as the first faint ray of color; and passing through the whole range, progressing from the faintest to the deepest shade, from Order to Order, finally end at jet Black, which I consider as the point where color terminates—all the colored rays being absorbed and none reflected.

The simplicity of these prescriptions will convey to the mind of the Dyer at a single glance what is most essential and important for him to know, viz.: the constitution of the Color; my object being to burden my recipes with nothing useless, nor to repeat with each color the kind of workmanship required to produce it, the time of boiling the Dyestuffs, &c., but merely the names and quantities of the ingredients constituting the colors, with the time required to fix them upon the wool, cloth, &c., and in certain cases the temperature at which this is to be effected.

To preserve regularity, these recipes are all given to one common standard—that is, each for 100 lbs. of scoured wool, of a medium quality, and all the dyestuffs used being of the very best kind; so that the dyer in coloring from any particular recipe here laid down, will have to bear in mind these circumstances, and proportion the quantity of the materials according to the weight and quality of the wool he is about to color, and according to the greater or less strength of the materials he has to use, remembering to use more for qualities finer than a medium, and less for the coarser, and more in proportion for a less quantity than 100 lbs. of wool, and a little less in proportion when from 300 to 500 lbs. are colored. The calculations he will make by the Common Rule of Three.

As said before, there is nothing in these recipes but the mere weight of the ingredients that compose the color (for which the prescription is given) to dye 100 lbs. of clean wool of a middle quality; and the time of boiling there mentioned, is not what is required to extract the color from the dyestuffs, but the length of time the wool requires boiling in the liquor, after the coloring matter has been previously extracted, or the chemical salts dissolved.

For the time necessary, and the manner of preparing the Dyeing Baths or Liquors, see the article "On the Treatment of the Dyestuffs;" and for the method of working the wool in the kettle, see the article treating on the "Manipulations of Dyeing," where you find described, once and for all, everything that is necessary to be done in dyeing any of the colors laid down in this work.

I wrote these separate articles explaining the treatment the wool should receive in dyeing, &c., and the time of boiling up the dyestuffs, on purpose to free these recipes from the common usage of repeating with every one of them, how to handle the wool, how long to boil the dyestuffs, &c., &c.; which repetition always loads the recipe with useless matter, that serves only to swell the size of the book; and at the same time perplex the mind of the dyer, and cause him to vary the plan of his operations.

From having adopted this plan, the recipes appear simply and plainly as the mere account of the quantity and kind of materials to be used in dyeing 100 lbs. of clean wool any specific color, and one uniform style of proceedings relating to the handling of the wool and the preparations of the dyeing baths, being common to all, makes a knowledge of these colors, and the methods of dyeing them, easy of acquisition to the student in this art, and fixes them indellibly on his memory.

Wherever the temperature is given, it is always so many degrees of Fahrenheit's thermometer.

In closing, the reader will perceive that some amount of labor has been bestowed upon these recipes, in the calculations of their proportions, independently of any other consideration about their arrangement in a regular series of succession, &c. &c.; for I had to collect them from memoranda of my own experience, written during the course of many years' practice, in England and the United States; and each of these memoranda was to reduce to one common standard or per centage, which cost about 500 calculations by the Rule of Three.

N. B. I have given the common names in use, in the Dye-house and by the public, to the colors forming this arrangement, instead of identifying the different species and varieties by numbers, as I originally intended; because, thinking that though these names are only temporary, and subject to change, every few years bringing up again the same colors under different appellations, yet as I wanted to make it as practical a work as possible, this method seemed to me the most familiar and natural to the dyer, and would be the easiest way for him to find any color, the composition of which he wanted to become acquainted with.

PRIMARY CLASS OF COLORS.

The first arrangement or class of colors, I term Primary or Elementary, because they are the original elements of which all the others are composed; in reality, these three are the only *positive* colors, as I have fully proved by showing that all the rest are mere results derived from the combinations of Yellow, Red and Blue, in different proportions.

I have taken Yellow as the commencing point of color, its faintest shade approximating the nearest to white. These three form one-half of the prismatic colors, or the colors we observe in the rainbow, the other three being Aurora, Violet, and Green; and as these six colors have all been pronounced simple rays by one of the most illustrious men that the world ever produced, and as this idea has passed down to the present time as an axiom in philosophy, it will seem nothing short of profanity or the height of presumption in me, to call in question the ideas of one whose opinion carries with it all the force and sanctity of an oracle.

Yet I should not be discharging my duty in treating on the subject of colors, were I to allow anything touching their fundamental principles to be held back, through fear of clashing with common received opinions, or the assertions of any individual, however high he may stand on the list of fame, or whatever credence may be attached to his particular theory.

Buoyed up by the consciousness of the correctness of my views, and being supported and borne out by the strength of natural truth, I shall, with appropriate feelings, dare to dispute the assertion of one of the greatest characters that ever lived; and in the sequel I hope to show, that there is a wide difference between the *opinions* of the greatest men, and the *simplicity and power of positive facts.*

Sir Isaac Newton, on beholding light decomposed by the prism into its component colors, imagined that all the colors he observed in the solar spectrum, must be simple or elementary and undecomposable rays, and as such he defines them.

This information, coming from so high a source, has been received as a self-evident truth by men of the greatest acquirements, from his time to the present, without examination. The expressed sentiments of so profound a philosopher as he was, having borne along with them almost the same deference and homage as we are accustomed to pay to the language of Sacred Writ, has disarmed us from entertaining even the suspicion of an idea that it was possible for him to err.

But it behooves me to say, (in despite of the sanctity attached to so great a name,) that I humbly, but firmly, believe, that in this instance, he has made a mistake; and it now only remains for me to state the reasons upon which I found that belief.

In the first place, we all know positively, that any body, substance or appearance which can be produced artificially by two or more bodies, substances or appearances, cannot naturally be a simple or elementary principle, but is capable (by proper means) of being separated into its original parts, and its compound nature exhibited to the senses.

On these data, then, I shall endeavor to prove the complex composition of the Aurora, the Violet and the Green rays, as manifested to us in the rainbow or the solar spectrum.

I hold that the solar rays do not leave the prism for the spectrum in a direct and continuous plane, but that they issue from the prism and continue to the spectrum in the form of an elongated hollow cone, and that all around its circumference, from its apex to its base, the original colors of which light is composed, arrange themselves in a systematic manner, the Aurora always being placed between the Yellow and the Blue, the Violet between the Blue and the Red, and the Green between the Blue and the Yellow.

From this mode of arrangement it appears clear to me that the Aurora, the Violet and the Green colors are merely the united reflections of the two simple rays whose union we know goes respectively to the production of the other three separate colors, and that these last are not in themselves positive and substantial, or component beams of light, but simply the inflections of the other simple and material beams which are the only true and constitutional elements of light; and it is my opinion, that in the ages to come, instruments will be invented which, interposing between any two of the simple or primary rays, will prevent the color resulting from their union exhibiting itself upon the spectrum.

And I doubt not, but in our present state of knowledge, we could ascertain this seeming fact by the interposition of an opaque body (say some metallic plate) between those simple rays of light which I consider, as giving by their reflections, the compound ones; for instance, the Aurora, Violet and Green.

Having thus given my opinion in regard to this matter, I leave it for the philosopher and man of science to investigate.

ORDER.--YELLOW.

THERE is no coloring matter so abundantly distributed through nature as Yellow; almost all vegetable substances furnish it in greater or less quantities, of a brighter or duller shade, and of a more or less permanent character. Its field is the whole range of the floral kingdom.

Among those substances that furnish it in the greatest quantity, we may reckon turmeric, dyer's bróom, (growing in England,) Turkey, French or Persian berries, young Fustic or American Shumac, Coccas Indicus, fennel, clover and mustard seeds, and a multitude of other plants and vegetable productions; but as these neither give so permanent or so cheap a yellow as several other dyestuffs, they are very rarely used upon woolen goods. For this reason I have only given recipes for dyeing Yellow with such dyestuffs as are commonly used, and which give the color of a brighter and more permanent shade, and at a cheaper rate, viz: quercitron, weld, heath and fustic.

The Yellow coloring matter from all these substances exhibit, with re-agents, the following general characteristics:

Acids brighten up their solutions, causing them to assume the Lemon shade; alkalies deepen and make them pass more towards Orange; alum gives a precipitate of a greenish Yellow hue; solutions of tin give one of a more decided Yellow, especially the muriate of tin, which throws down an abundant precipitate of a full Yellow, having an Orange shade; acetate of lead gives a dull, poor color, and any of the soluble solutions of lime or magnesia act in a similar manner, and can be of no service as mordants for this color; sulphate of copper produces a shade something like "gosling-green;" and sulphate of iron an Olive. The mordants employed for dyeing Yellow are, therefore, alum, supertartrate of potash, and the different solutions of tin.

In dyeing these colors, great care should be taken to have every thing clean in the Dye-house and about the kettle. It is also necessary to clear the water previous to making the dyeing liquors, and this is done by throwing into it a pound or two of alum and three or four quarts of wheat bran, and after letting it stay in a while, skim off the bran, before the water comes to boil. This carries out all the impurities with it.

Purge or purify the water as above, at all times, for all the fine and delicate colors.

Then boil out the dyestuffs in bags, and proceed to color the wool as described in the article "On the Operations of Dyeing."

RECIPES FOR ORDER YELLOW.

FUSTIC YELLOW.

Chiefly used for either Listing or for Mixtures.—A very permanent Color.

Mordant Process.

Potash Sulphate of Alumina, 10 lbs.
Super-Tartrate of Potash, 2½ lbs.
Murio-Sulphate of Tin, 2½ lbs.

Boil two hours.

Dyeing Process.

Fustic, 33 lbs.

Boil one hour.

FUSTIC YELLOW.

Dyeing Process.

Fustic, 33 lbs.
Super-Tartrate of Potash, 2½ lbs.

Boil two hours.

Mordant Process.

Potash-Sulphate of Alumina, 5 lbs.
Murio-Sulphate of Tin, 2½ lbs.

Boil one hour.

FUSTIC YELLOW.

Aggregate Process.

Fustic, 33 lbs.
Super-Tartrate of Potash, 2½ lbs.
Potash-Sulphate of Alumina, 5 lbs.
Murio-Sulphate of Tin 2½ lbs.

Boil one hour.

RECIPES FOR YELLOW.

SULPHUR.

Quercitron Bark, 2½ lbs.
Potash-Sulphate of Alumina, 2½lbs.
Super-Tartrate of Potash. 5 lbs.
Sulpho-Muriate of Tin, 2½ lbs.

Use all these together, with the addition of a very little Sulphate of Indigo, merely to give the peculiar tinge of the green due to the color of Sulphur.

Boil the wool one hour.

CANARY COLOR.

Quercitron Bark, 5 lbs.
Potash-Sulphate of Alumina, 5 lbs.
Supertrate-Tartrate of Potash, 5 lbs.
Nitro-Muriate of Tin, 2½ lbs.

A little Sulphate of Indigo may be required in this shade also.

Use all the articles together, and handle the wool in them for one hour at 200 degrees.

BARK YELLOW.

Quercitron Bark, 12½ lbs.
Potash-Sulphate of Alumina, 3 lbs.
Super-Tartrate of Potash, 3 lbs.
Muriate of Tin, 2½ lbs.
Nitro-Muriate of Tin, 3 lbs.

Use all these together, and give one hour's gentle boil to the wool.

In all the cases of coloring the finer shades of yellow, &c., with bark, be careful not to boil that article; but rather stew it, at the temperature of 200 degrees. A boil or ebullition extracts too much tannin from the bark to answer the purpose of dyeing. We want for the production of colors, what I have, in this work, appellated the "coloring principle" *only*.

I wish you continually to bear in mind, that there is a wide difference between the Tannin-matter and that Principle which gives or produces colors, proper; and that all vegetable substances, as a general rule, contain these two principles in combination, and the best mode of separating them that I am acquainted with, is (especially in the case of barks) to use one-fifteenth of the weight of the bark of a solution of gelatine or glue, which precipitates the tannin and leaves the pure coloring principle in solution.

I recommend the adoption of the last-named plan in all the more delicate shades of Yellow. But I want you to remember that the gelatine, otherwise called fine glue, must be given to the solution of bark before any of the earthy or metallic salts are added to it.

BARK GOLD COLOR.

Quercitron Bark, 25 lbs.
Potash-Sulphate of Alumina, 5 lbs.
Super-Tartrate of Potash, 5 lbs.
Murio-Sulphate of Tin, 9 lbs.

Use all these together, and handle the wool for about one hour in this solution at 200 degrees.

I will observe that there is an objection to bringing up to a boil for any of these colors.

WELD OR WOALD YELLOW.

Potash-Sulphate Alumina, 15 lbs.

Boil two hours.

Dyeing Process.

Weld or Woald, 75 lbs.
Pearl-Ash, 1 lb.
Or Human Urine, 1½ gallons.

Boil one hour and a half.

ANOTHER WELD YELLOW.

Aggregate Process.

Weld, 100 lbs.
Potash-Sulphate of Alumina 14 lbs.
Super-Tartrate of Potash, 2 lbs.
Murio-Sulphate of Tin, 5 lbs.

Boil out the Weld first, and withdraw the bag or bags; then add the mordant, and when that is dissolved enter the wool, and boil one hour.

WELD.—GOLD COLOR.

Weld or Woald, 100 lbs.
Potash-Sulphate of Alumina, 7 lbs.
Super-Tartrate of Potash, 3 lbs.
Murio-Sulphate of Tin, 7 lbs.

Use these all together, and boil the wool up in them for three-fourths of an hour; then raise the wool out and give from four to eight ounces (according to shade) of ground cochineal, and boil one half or three-fourths of an hour.

HEATH YELLOW.

In the first place, in dyeing this color, boil up from 50 to 100 lbs. of Heath (in quantity according to shade) for three hours. Then, after taking out the bags, add to the dyeing liquor the following articles or ingredients:

Potash-Sulphate of Alumina, 5 lbs.
Super-Tartrate of Potash, 5 lbs.
Saturated Solution of Muriate of Tin, 3½ lbs.
Nitro Muriate of Tin, 3½ lbs.

After these are all dissolved, enter the wool and boil the same gently for one hour.

The color produced from this article is equally permanent, and almost as beautiful as Weld. No other dyestuff approaches so near the enviable properties of Weld as Heath does.

Its various shades may be produced by a greater or less quantity of the Heath, and by a judicious use of the various salts composing the mordant.

I wish to observe here, that this plant, which I term Heath, as being the provincial name of an herb or herbaceous shrub, growing spontaneously on the mountains or uncultivated tracts of land in the Island of Great Britain, I do not remember having seen in any part of the United States. It resembles most in its structure and composition, the sweet-scented fern of these latitudes.

ORDER-RED.

THE materials that supply the coloring matter for this Order, are not so abundant or widely spread as those from which we obtain the Yellow, being productions only of the warm or temperate portion of the earth; some of them are of animal and some of vegetable origin.

Being found only in the warm or genial latitudes, I infer from this circumstance that it requires more of the sun's action to create the Red, than to bring to maturity the Yellow coloring principle.

The color afforded by almost all these substances is of a permanent character—that from Kermes, Cochineal, Lac, Madder and Munjeet being equally as durable as Indigo Blue.

Kermes is very little, or not at all, used by the European and American Dyers, but it is extensively employed in Asia Minor and the countries to the east of it, and produces a deep Red, bordering upon Maroon, but yet of considerable brightness and great durability.

The mordant for it is alum and tartar—solutions of tin brighten it some, but do not produce the same effect as upon cochineal or lac, and at the same time it renders it less permanent.

Cochineal and lac, by means of the solutions of tin, produce the most superb colors that the whole Materiæ tinctoria affords.

Madder and Munjeet give us a common Red, not comparable, however, to the Scarlet, in beauty and brilliancy, but exceeding it in permanence.

The mordants for these are alum, super-tartrate of potash, and a little solution of tin, or not, at pleasure.

Munjeet gives a more desirable shade than madder, and is equally as durable.

The woods that give us the Red color, such as Peach-wood, Hypernic, &c., give a good common red; but one which is only fugitive, and is never employed but for ordinary purposes.

The mordants for these are alum and super-tartrate of potash only.

In dyeing the whole of this order of colors, much of the effect depends upon cleanliness and taking care to have all the solutions clear and limpid; the alum, &c., as well as the rest of the dyestuffs, of a good quality, and free from any dirt or mixture of other materials. After dyeing let them be washed off and dried in the open air, with the exception of the wood colors, which are better if dried in the shade.

RECIPES FOR RED.

PINK.

Nitro-Muriate of Tin, 3 pints.
Potash-Sulphate Alumina, 3 lbs.
Super-Tartrate of Potash, 3 lbs.
Cochineal, 3 lbs.

When these articles are all thoroughly dissolved, enter the wool and boil an hour or an hour and a half, and let it be washed off the same day, Which course adopt with all colors having a mordant composed as the above. You will also make a paste of the Cochineal (that is, an ammoniated Cochineal) for all those colors which have the Pink or Crimson hue to them; which is made by digesting Cochineal with about an equal weight of aqua Ammonia for 24 hours or longer before using it.

ROSE.

Nitro-Muriate of Tin, 4 ½pints.
Potash-Sulphate of Alumina, 4½ lbs.
Super-Tartrate of Potash, 4½ lbs.
Cochineal, 6 lbs.

Boil the wool one half hour.

CRIMSON.

Nitro-Muriate of Tin, 6 pints.
Potash-Sulphate of Alumina, 6 lbs.
Super-Tartrate of Potash, 6 lbs.
Cochineal, 10 lbs.

Treat this color the same as the Pink and Rose.

GARNET OR BEET ROOT.

The recipe for crimson, increased one-third with one hour and a half boil; then washed, and in a fresh bath of water boil up the wool half an hour, with 5 lbs. of Cudbear and one pail of stale Urine.

A saving of Cochineal may be effected on all of the above colors, by substituting one-third of the Cochineal with Cudbear, and after the Cochineal and mordants have been worked on to the wool, taking out and washing, then finishing off with the Cudbear in a clear bath of boiling water for one-half an hour; then run about half the liquor off, and run the kettle up again with cold water; work in a pail of Urine in this cool liquor for the purpose of blueing the color a little. But this method does not afford as bright or permanent a color as when Cochineal is used only as the dyestuff: and it creates more labor and trouble in the dyeing than the former process.

GERANIUM.

Dyeing Process.

Potash-Sulphate of Alumina, 2½ lbs.
Nitro-Muriate of Tin, 2½ lbs.
Super-Tartrate of Potash, 10 lbs.
Cochineal, 7 lbs.

Boil one-half hour; take out and wash off.

Heightening Process.

Bring a bath of fresh water to 120 degrees, and dissolve in it 1 lb. of Soda and 1 lb. of Muriate of Ammonia. Work the wool in this for one-half an hour, or till you shade the pattern.

PEACHWOOD CRIMSON.

Potash-Sulphate of Alumina, 15 lbs.
Super-Tartrate of Potash (White Argol,) 3 lbs.
Sulphate of Copper, 1 lb.

Boil two hours and a half, and leave in the kettle all night.

Dyeing Process—Fresh Bath.

Hypernic or Peachwood, 50 lbs.

Enter the wool at 170 degrees; bring up in 15 or 20 minutes.

Heightening Process.

Fresh bath at 150 degrees, with two pails of Urine; work one-half an hour.

COCHINEAL SCARLET.

Aggregate Process.

Young Fustic, 5 lbs.
Cochineal, 10 lbs.
Super-Tartrate of Potash, 10 lbs.
Nitro-Muriate of Tin, 10 pints.

Boil 1½ hours.

ANOTHER METHOD.

Mordant Process.

Young Fustic, 7½ lbs.
Cochineal, 2½ lbs.
Super-Tartrate of Potash, 7 lbs.
Nitro-Muriate of Tin, 3½ pints.

Boil one hour and a half.

Dyeing Process—Fresh Bath.

Cochineal, 7½ lbs.
Super-Tartrate of Potash, 3 lbs.
Nitro-Muriate of Tin, 6½ pints.

Boil one hour and wash off.

LAC SCARLET.

Young Fustic, 7½ lbs.
Best Lac Dye, 15 to 20 lbs.
Super-Tartrate of Potash, 10 to 12½ lbs.
Nitro-Muriate of Tin, 10 to 12½ pints.

Boil one to one and a half hours, and wash off well all the scarlet colors soon as possible after coming from the kettle.

If you cannot obtain young Fustic, use common Fustic, or 2½ lbs. Quercitron Bark.

MUNJEET RED.

Mordant Process.

Potash-Sulphate of Alumina, 20 lbs.
Super-Tartrate of Potash (or Argol,) 5 lbs.

Boil two and a half hours, and let the wool remain in the Mordant all night. In the morning wash thoroughly.

Dyeing Process.

Fresh bath; bring this up to 120 degrees; then give

Munjeet, 33 lbs.
Muriate of Tin, 2½ lbs.

Enter the wool and let it be well handled until near a boil, which continue for about ten minutes; then heave out and wash.

By the addition of 5 lbs. of Hypernic wood you will obtain a bloomier color.

PEACHWOOD RED.

Mordant Process—Same as Munjeet Red.

Dyeing Process.

Fresh bath; bring this to 170 degrees; then give

Peachwood or Hypernic, 33 lbs.
Fustic, 5 lbs.

Proceed as with Munjeet Red, and boil half an hour.

MADDER RED.

Mordant Process—Same as Munjeet Red.

Dyeing Process.

Bring up a bath of fresh water to 120 degrees; then give

Best Crop-Madder, 35 lbs.
Wheat Bran, 2½ gallons.

After working the wool in this till the heat arrives at 190 degs., give 1½ to 2 lbs. Nitro-Muriate of Tin, and still work the wool till you just strike a gentle boil not exceeding five minutes duration; heave out and wash.

By adding 5 or 6 lbs. Hypernic or Peachwood, with the Madder, you will obtain a more rosy shade.

ANOTHER RED, very durable and beautiful, may be made by *mordanting* as for the Munjeet Red, and using in the

Dyeing Process.

Madder,	12 lbs.
Munjeet,	12 lbs.
Madder-Roots,	12 lbs.
Nitro-Muriate of Tin,	3 lbs.

And in all other respects proceeding as above.

ORDER-BLUE.

I HAVE ranked this as the last Order of the Primary Class, as I consider it further removed from White than either of the other two.

The substances that afford Blue are few in number, and the regions producing them are about or within the tropics.

Blue coloring matter being produced nowhere but in the hottest climates, evidences that it requires more intense solar influence to produce it than either Red or Yellow.

I know of no substances that can be found in sufficient quantities, or used to advantage in producing this color, with the exception of Indigo, Logwood, and Prussiate of Potash, and even the two latter are but sparingly employed; but more especially Logwood, which is so miserably fugitive and deceptive that no honest manufacturer or Dyer will color a Blue by it, if he can any way avoid it.

From this, it appears that the whole amount of wearable Blues are produced from the single article of Indigo alone; of which the consumption in different countries is amazingly great. And although there are a few light acid, or Saxon Blues, colored with Sulphate of Indigo, yet these exceptions are so light, in comparison with the bulk, that we may safely say the whole quantity of permanent Blues are produced from Indigo, by means of fermentation in a Vat; the method of conducting which will be detailed on the next pages.

Indigo Blue is one of the most permanent and beautiful of Dyes, and there being no other article in the world that will produce so desirable a color, I make no hesitation in asserting that Indigo must have been the universal material from which all nations, ancient and modern, savage and civilized, have produced their Blues.

Numberless attempts have been made, in different countries, to find a substitute for it, on account of its price and the trouble and expense of Dyeing with it; but all experiments have failed, hitherto, in producing anything to supply its place.

In Dyeing Saxon and Prussian Blues, care must be taken to have every thing clean, and nothing of an alkaline nature round where they are, as they easily spot and discharge; and the water of the kettle must have the impurities removed with bran, &c., before making up the Dyeing liquor, in the same manner as I have described for Yellow and Red Dyeing.

As soon as they are Dyed, they should be washed off and dried in the most expeditious manner; the Saxon Blue in the shade and the Prussian Blue in the open air, if convenient.

On Dyeing Logwood Blue, little or nothing further than what you will find in its recipes, needs to be said, for it is a miserable thing at the best.

WOADED BLUE.

This is one of the fastest as well as being among the handsomest colors that the art of the Dyer can produce. It is also the softest and kindliest in its action upon the wool, which it softens and feeds, improving its handle and quality very much; it is much easier to work through all the operations of manufacturing than any other color; nay, a good woaded Blue will work milder and better than white wool.

Those good qualities are all due to the woad as the principal agent in this mode of Dyeing.

We are indebted to the ancient Britons for this invaluable method of coloring Blue; and their descendants, during the run of many ages, have been practicing and improving upon it, until they have arrived at a system at once grand and beautiful; and the ease with which the English woad-man manages thirty or forty or more woad-vats, is unknown to the Dyers of any other country, and the certainty and efficiency of his plan produces Blues so permanent and beautiful that they stand pre-eminent in every market in the world.

By the ancient inhabitants of England, Woad was used for Dyeing purposes from time immemorial; long before the invasion of that country by Julius Cæsar, the Britons employed it both in staining their bodies to terrify their enemies in battle, and in coloring such garments as they wore in times of peace; and the only Blues they had in use for ages, were Dyed exclusively with it, until the discovery of the passage to India by the Cape of Good Hope, opened the treasures of the East to British skill and enterprise, when the introduction of Indigo into their woad-vats formed a new era in the art of Dyeing, and commenced that System of coloring Blue which I am now about to describe.

The management of a Woad-vat, depending upon the regularity with which the fermentation of a large body of vegetable matter is kept up and restrained within certain bounds, (which fermentation is liable to be disturbed by many unforeseen circumstances and accidents,) makes it utterly impossible to give any written account whereby a person unacquainted with their management, could take hold and conduct one of these Vats without the most certain prospect of destroying it.

From this it will appear almost needless to say that no one ought to be suffered to engage in such an undertaking, except he has had a very extensive practice in the business; for without considerable practical experience, very close observation, and a thorough knowledge of the effects produced on a vat, by the different articles employed in the process of conducting it, no person can run one without imminent risk and certain loss.

From these very superficial observations, and taking into consideration the value of the property invested in the Vat, independent of other loss and inconvenience resulting from the bad management of one, it will readily be perceived that a good woad-man can never be too highly valued; and a few dollars, or some slight misunderstanding, ought never to occasion a separation between him and his employer.

My object in this slight description of a Woad-vat, is not to stimulate the raw and inexperienced to attempt the management of this so difficult and inexplicable a part of Dyeing, and by so doing run themselves into disgrace, and those who have employed them into loss, but only to give a general outline of the common or usual method of setting and conducting a Woad-vat, so that those who have had no opportunity of observing the practice, may form some idea respecting the mode of working one.

We generally contrive it so as to put the ingredients of the Vat together, or (in the language of dyers) to set on Saturday afternoon; because, as the fermentation generally commences, or the Vat springs, in the course of twelve or fourteen hours after it is put together, and it then requires the calm and undivided attention of the

Artist to regulate its operations and accelerate its progress towards a working condition; and Sunday, being a day of rest and quiet, affords the workman the best opportunity of coolly and undisturbedly noticing the changes presented by the Vat during the process of fermentation, and of checking or encouraging it, as circumstances may require.

As the attention and skill required by the Vat the first day after setting is greater than at any other period, and is of the utmost consequence to its well-doing afterwards, it becomes necessary that the Dyer should be at perfect liberty to attend to it at the precise time necessary to produce the best effect upon it.

It is also very essential that his mind should be calm and at ease—that he should divest himself of all other cares than the one now under consideration.

And as no other day affords these facilities like the Sabbath, that has been chosen by Dyers, everywhere, as the most proper time to attempt the important and anxious task of bringing the Vat to work. A day when the cares and perplexities of life are laid aside—a time when all is still and quiet without, and calm and peaceful within, has been pointed out by necessity, to them, as the best fitted to produce the wished-for results, and it is generally attended with such success that the Vat is ready for coloring on Monday morning.

I have known the same Dyers who have had good success on the Sabbath, by taking some other day of the week, to be three, four or more days in getting the Vat into operation; because, the mind, getting disturbed and bothered by a multiplicity of cares, and the Dyer being fixedly engaged on some other business, could not attend to the Vat at the most critical stages of its progress; and the natural consequences were to throw it back or retard its operation so as to make it difficult to bring it into working order.

I have no other apology to offer for this seeming violation of the Sabbath, than to say it is as much a work of necessity as gathering in the harvest in a wet season on the Sabbath, or for the divine to ride to the church, for the obvious reason that the church could not come to the divine. The Dyer must attend to his Vat, for the operations of nature cease not, either for the rotation of the Sabbath, or the institutions of men. The Sabbath was made for man, not man for the Sabbath.

WOADED—BLUE.

USUAL OR COMMON MODE OF SETTING A WOAD-VAT.

To set a Vat of seven feet deep and six feet diameter, the usual plan is to proceed as follows:

The day previous to setting the Vat, have it clean and emptied of your old worked-out liquor sediment. Then throw into it 500 weight of good Woad, well chopped into small pieces, and if it be hard and dry, run on to it five or six barrels of cold water. Let it soak in this all night; which will loosen, soften, and help it to dissolve.

About noon the next day have ready a kettle of water at 160 degrees; run this into the Vat until it is half full; then have in two or three rakes and let your men rake up powerfully and laboriously, at intervals, for an hour, or until they have got the Woad entirely reduced into a pulpy state, and no lumps remain unbroken.

After this fill up your Vat till within six inches of the top with water at 200 degrees; this will bring the whole liquor to about 175 degrees. Then put in the following articles:

Best Crop Madder, 10 lbs.; good broad wheat bran, 20 quarts; Bengal Indigo, 40 lbs.; pure Lime, nicely slacked and sifted into a fine powder (Hydrate of Lime,) 10 lbs., called by the Dyers, when in this state, *Ware;* which term always having been accustomed to, I shall invariably use when speaking of it in connection with Blue Dyeing.

Rake up powerfully, for half an hour, or till all these ingredients be thoroughly intermingled.

Cover the Vat up for the night.

Be at the Vat early in the morning; uncover it and cast your eye carefully over its surface; observe if there be not some bubbles standing about; take some of them gently up with your fingers, and you will perceive that they are tougher and have more consistence than the bubbles that form upon water. Now look upon the smooth surface of the Vat and see if there be not a thin film of Indigo of a blueish or purple shade upon it, which you can skim off with your thumb nail; then take a *hawk*, or a small stick in your hand, and inclining it between the perpendicular and plane, (angle of 45 degrees,) plunge it two or three inches beneath the surface of the liquor, and agitate this transversely and briskly, so as to raise a froth or a number of bubbles; take these up between your two first fingers; part the fingers, and then observe if the bubbles stand full, without breaking quite so quick as those of water. Again, take your dish and dip up some of the vat-liquor; let this run gently over the side of the dish into the Vat again, and while it is so doing, look through the passing liquor towards the light, and it will appear of a deep Green or Olive color.

Having gone over this examination, and ascertained that your Vat exhibits these features and characteristics, it indicates that the Vat, in the language of Dyers, is *sprung*, or has sprung its Indigo —in other words, a portion of the Indigo has become deoxydized by the fermentation of the Woad, Madder, and Bran, and is in want of some alkaline matter to bring it into solution. Serve it with 5 lbs. of Ware, and let it be gently but well raked up, avoiding all unnecessary agitation with the rakes. Cover it up and let it stand two hours; after which time look at it again, and suspend a lock of scoured wool in it for ten or fifteen minutes. This will come out a yellowish Green, and it will take above five minutes before it becomes entirely Blue.

Lay this lock aside, to compare with the sample that you may try the next time you examine the Vat.

Examine the surface of the Vat again, and you will observe the quantity of bubbles have greatly increased, and a well characterized *flurree* has formed and lies well to the back side of the Vat, and has become *sadder* and more consistent than it was previous to the first raking. It also looks richer in color; the scum or pellicle of Indigo has become thicker and more coppery, and on moving the liquor about with the hands, green veins or waves may be perceived.

The Vat is now opening; examine with the dish, as before, and you see the liquor has become of a still yellower green or olive appearance, indicating a further deoxydation of the Indigo, and a want of more Ware. Serve it with 5 lbs. of Ware, and rake as before.

Cover up and let it stand three hours. After the expiration of this time, suspend a second lock of wool for ten or fifteen minutes in the Vat; when it comes out, it should be of a deeper shade, and more like a grass green than the first lock was: it will take a little over five minutes to *ungreen* it, when it will assume almost a Middle Blue, with a slight tinge of Green, after it has been exposed to the air for half an hour.

Compare this with your first sample, when you will observe that it is a much deeper and clearer Blue than the first.

This shows that the Vat is going on and progressing well, although still short of Ware.

A slight observation of the smooth part of the Vat convinces you of its improved condition, the scum or pellicle looking richer and more glossy; and on blowing vertically upon it with your mouth, you will see the scum of Indigo open in a circle, showing the clear liquor beneath it of a yellowish Green, and the circle closing over it again, on withdrawing your breath.

Waving the surface about with your hands, the veins or wavy shades of color are of a livelier and yellower Green than in the former examination: they spread wider and seem to roll about much longer, and the color begins to strike your hand quicker and deeper.

The *flurree* is also much more in quantity and looms well up on the back part of the Vat, covering more space than before, the bubbles being large and of a fine Indigo Blue color. Serve it with 5 lbs. of Ware; rake and cover up; let it rest four hours.

After this time, again look to it; another lock of wool, suspended for twenty or thirty minutes, on coming out should appear of a deep rich Green, and in about five minutes change to a bright, lively, even, Middle Blue, with a slight tinge of Purple to it.

If this Green in any case, passes to a pale, greyish looking Blue, in two or three minutes, it shows the Vat has too much Ware, or is hard; and again, if after exposing it to the atmosphere for fifteen or twenty minutes it continues with a greenish cast, this is as certain a criterion of its being short of Ware; or the Vat is soft.

Now give a glance at the uncovered Vat, when you will perceive the *flurree* to have still further accumulated, occupying a considerable part of the surface, the rest presenting a fine, smooth, glossy and Purple appearance. Blow strongly upon this, when a circle will open of an inch or two diameter, showing the internal liquor of a fine gold color, or in some cases of a rich yellowish Green. On withdrawing your breath, the circle will gradually close again.

The bubbles forming the *flurree* are numerous and of various sizes, some of them being as large as a hen's egg and of a beautiful Indigo color; they stand well, not easily breaking or falling down; even when strongly agitated.

On waving the clear surface from side to side with your hand, the pellicle of reoxydized Indigo passes off towards the junction of the *flurree* with the sides of the Vat, running tremulously in its wake, appearing silky and throwing off all the Indigo shades, from the lightest Blue to the richest Purple.

The wavy veins are now larger, wider, and roll about more than before; the body of the liquor being of a rich Yellow, intermixed with the various shades of Green derivable from Blue and Yellow.

On examining the liquor with the dish, you will notice that it looks well, having a good strong body, and on turning the dish with the mouth towards you in a perpendicular manner, the liquor hangs suspended from its lower edge, like a fine syrup, and throws off a fragrant and agreeable smell.

On the whole, the *tout ensemble* of the Vat presents a splendid and beautiful appearance, and everything about it shows that it has received its complement of Ware, and is now perfectly safe and in excellent working condition.

Although there may be cases where a Vat sometimes requires more and sometimes less Ware than the above, owing to the variation in the strength of the Woad and the quality of the Lime, yet as a general rule 500 weight of Woad requires from 25 to 30 lbs. of Ware.

By taking the plan here pointed out, and supposing the materials to be of the best quality, all these changes and appearances will take place, and the progress of the Vat will be as certain as the above short description has represented it to be; so much so that in nineteen cases out of twenty it will be brought to work the day after it is set, and can be colored in on the succeeding morning.

During all this time take care to keep the heat from dissipating, never suffering it to fall below 135 degrees, at the lowest.

ON THE OPERATIONS CONNECTED WITH DYEING WOOL IN THE WOAD-VAT, AND THE PLAN OF CONDUCTING THAT FROM DAY TO DAY, WHEN COLORING IN IT.

For a Vat of the size specified in the preceding pages, take from 50 to 75 lbs. of clean wool, well scoured and evenly drained; shake this over in front of the Vat, taking great care to have every lock of it well opened, so that the whole pile may be loose and feathery. This is done in view of its taking the color evenly and all alike.

Uncover the Vat and skim off the *flurree* into a pail, and put that aside in order to return it into the Vat after finishing your day's coloring.

Suspend the trammel and net; or if you use a strainer, lower that into the liquor; then let a couple of hands throw the wool lightly and briskly into the Vat, (picking up all the locks,) getting it under the liquor as quick as possible; then handle it expeditiously with the stick until the whole is even, and continue a steady gentle handling of it for about an hour.

Now take out, and after either letting it drain well or having it strongly wrung out, throw it upon the floor, and shake the whole over, so that it may *ungreen* as quickly as possible.

This operation diffuses through the Dye-house a grateful ammonical odor, which rises from the wool, very stimulating and invigorating to the human system, and cheering and enlivening to the mind.

If you have an old and weak Vat, you should prefer to return or finish it in that; but if you have not, then take a sample of this wool and compare it with the pattern you are coloring to, and see whether you can bring up the shade required, without raking the Vat; if you find you cannot, then have it well raked, and after letting it repose two or three hours, enter the wool again, proceeding as before, only not allowing the wool to stay in any longer than is necessary to bring up the color to the desired shade.

When it comes out, shake the wool over, and when it is fairly ungreened let it be well washed.

Serve the Vat up, giving it this time 5 lbs. of Ware; rake up well and cover the Vat.

Let all these operations be concluded by three or four o'clock in the afternoon, so as to give the Vat time to rest and clear itself before the last raking time, and by this means it will give you an opportunity of judging of the precise state of the Vat—whether it is in want of *Ware*, or has got too much of it.

After raking, raise the heat as quick as may be to 130 degrees, the best temperature for working.

About seven o'clock, (or after letting it rest two or three hours,) go to the Vat and examine the liquor; see if this looks clear, *lithe*, and hangs well to the dish; scrutinize the top, noticing whether it carries the *flurree* well, and the smooth surface looks glossy; whether on blowing into it, it opens and shuts again gradually, as described in bringing the Vat to work.

Now smell at the edge of the dish; when, if the Vat have too much Ware, it will smell of the Lime; if short of it, it will smell vapid and soft.

In the latter case, give about 3 lbs. of Ware; in the former, serve with 4 or 5 lbs. of Madder and 6 or 8 quarts of bran; rake up well.

If the Vat be rightly balanced, it will have a fine, fragrant exhilarating smell.

The next day proceed with the same weight of wool, in the same manner; and serve, after coloring, with 3 to 5 lbs. of Ware, which will be about the quantity required for each day's coloring afterwards, with few exceptions.

After three or four days' work, you will have to renew the Vat with Indigo; this you will do when you rake up, on the last dip coming out; give it as much Indigo as you suppose the three or four days' Dyeing have taken out, as you will wish to keep up the strength of the Vat about the same as when it was first *set*, until such time as you are desirous to work it out, in order to set it afresh.

At the same time give it 5 lbs. of Madder, 2 quarts of bran, and 4 lbs. of Ware; rake well up, and in three hours, or about seven in the evening, examine the Vat, as usual, and if it has not *sprung* its Indigo, serve it with Madder and bran, or with Ware, as the case may require, and rake up well.

A good raking may probably answer this time without giving it anything, but your own experience and judgment must determine that, according to appearances.

Some Dyers serve with Indigo, &c., every day; others every two days, and others again at no particular stated periods, each having his own peculiar notions in this respect; it is a matter of little consequence which of these courses you take, but I think I should advise you to serve with Indigo, &c., as above stated, every Wednesday and Saturday afternoons.

On a Saturday afternoon you need not fire up the Vat, except it is convenient so to do; as you will have to attend to it on Sunday morning, because the usual quantity of heat given it on Saturday night, will not last till Monday morning, so as to be of the right temperature for coloring well.

If, in order to avoid attending to the Vat a few hours on Sunday morning, we give it an excess of heat on Saturday night, we thereby injure it more or less, as the Vat works in the easiest and most profitable manner, the more regular we keep the temperature; in fact, it is absolutely necessary to avoid extremes.

On this account, it makes it indispensable to attend to the Vat on Sunday—raising the heat to the proper point and giving it such materials as it may require, in order to put a force into it sufficient to perform the next week's work without distressing it.

If you regularly attend to this advice and see to getting the Vat into first-rate order on the Sabbath, you will give it an impetus that it will not forget during the week, and it will be almost impossible for it to get much out of the way before the next Sabbath gives you an opportunity of again waking its ideas and giving it a *fillup* that will stand it for another six days.

And so proceed, from week to week, until you decide upon working it out, in order to set anew, when you will have to cease giving it Indigo, and work out its contents as clean and as profitably as you can.

I do not advise running a Vat steadily over three or four months at the farthest, as the colors are neither so good or permanent when the Vat gets old; and the loss of Indigo by scouring and fulling is much more considerable than when Dyed in Vats that have not been so long worked.

In this description, I have only conducted the reader through the process of setting and working a Vat upon the most approved principles, and where everything has gone on in a straight-forward manner and with the most perfect success; because we have been to work upon the best materials, (which ought always to be the case,) and have been treating it in a workmanlike manner, and as men understanding thoroughly the business we were about, the nature of the materials we were operating upon, and knowing beforehand the certain effects of everything we employed, and every movement we made.

The reader will be satisfied that a short description of this kind, upon this most important and complicated department of Dyeing, is of more real utility than a volume of observations on the methods of getting a Vat right, after suffering it, by an injudicious mode of treatment, to get wrong.

It is easy to perceive that I could have said much more respecting the Woad-vat; for there are numberless appearances of the Vat and of the wool, which, if closely observed by the Dyer, will give him a certain knowledge of the precise state of the Vat, and will point out to him the materials it is most in want of: these I have not noticed.

By referring to the articles, Madder, Bran, Lime, Indigo, Woad, and Fermentation, found in their proper order in this volume, you will gain a great deal of additional valuable information on these subjects.

ASH-BLUE.

This is another mode of Dyeing Blue with Indigo, but it is not comparable with the Woad-vat, either in durability, beauty, or solidity of color, it is also more costly, and possesses none of those kindly qualities communicated to the wool when Dyed with Woad.

You will readily notice the inferiority of an ash-dyed Blue compared with one from the Woad-vat, a great paucity of color being perceptible; and in samples that look darker under-hand than a Woad-blue, on being held up and viewed by transmitted light, look thin and grey, and possess none of the vivacity and intensity of shade which you observe on the Woaded sample; this is owing to the coloring particles being coarser, and standing further apart on the ash-dyed Blue than they are on the Woaded one; they also lie more superficially upon the fibre of the wool, and there is no bottom or under-color, if I may so express myself, as in the case of the Woaded Blue.

All this is easily accounted for; for the solvent in one case, being a fixed alkali, (Potash,) and in the Woad-vat, a volatile one, (Ammonia,) the former making a thicker or coarser solution, the particles of Indigo are not so finely attenuated as in the ammoniacal solvent, and the coarse solution of Potash prevents the particles penetrating so far into the wool, and lays them upon it in a loose and more scattered manner.

Whereas, in the case of the Woad Blue, the ammonia which is the solvent of the Indigo, being a finer as well as a stronger alkali, divides the coloring molecules in a more minute and multifarious manner, and being of a more subtle nature, penetrates the body of the fibre better, and combines these finely divided particles more intimately with the wool, as the Indigo being more deeply fixed and divided into a greater number of surfaces, accounts for its superior permanence and brilliancy; for the greater the quantity of reflecting surfaces presented, and the minuter their division in any color, the higher the intensity of its shade.

The Woad also helps by the color it furnishes, to body up the wool, or aids with the under-color that it supplies, to give a greater depth of shade than would be obtained from the same quantity of Indigo without it.

This, then, accounts both for the superior permanence, beauty, and cheapness of the Woad over the Ash-Blue.

We have observed in treating of the Woad-vat, that it greatly improved the quality of the wool, and that this worked better in the operations of manufacturing than any other color; this, every one knows.

But the reverse of this is the case in the Ash-Blue; it works no better at any time, than the harshest Dyed Kettle color, let the Vat be in ever so good condition, or whether the Alkali be in a mild or caustic state.

These effects follow, whether Pearl or Potash is used; although Pearlash, containing more Carbonic acid than the Potash, is milder and softer; nevertheless, wool, Dyed Blue by this kind of Vat, is always harsh and tender, is more tedious to manufacture, fulls hard, and the finished goods never feel so soft or look so well as the Woad Dyed Blue.

As some Ash Dyers use Lime in their Vats, this will further increase the risk of injuring the wool, and has a tendency to augment the bad qualities we have pointed out, for the Lime renders the Potash caustic, which acts still more powerfully upon the wool, than when in a milder state.

These disadvantages of the Ash-Vat have caused it to be laid aside for the coloring of fine Kerseymeres and Broad Cloths; but it being so easy to manage that any common Dyer can conduct one, makes it still to be retained at some small establishments, among the custom shops, and by some country Dyers; and for the information of these, I shall give a description of the manner of setting and carrying one on.

The Ash-Vat is also used at some establishments for coloring cotton-warps Blue, used in the manufacture of Denims, striped shirting, bed-ticking, &c. &c., but neither for this purpose is it equal to either the Woad or the Jack-vat, either in beauty or permanence.

THE METHOD OF SETTING AN ASH-VAT.

For a Vat of 6 or 7 feet deep and 6 feet in diameter, we proceed to set in the following manner.

Fill this vessel with water to within 6 or 8 inches of the ledge, and heat it to 170 or 180 degrees.

Throw into this liquor 20 lbs. Potash, or in its place 25 lbs Pearl ash, 25 quarts Wheat Bran, 12½ lbs. Crop Madder, and 15 lbs. Bengal Indigo; give these ingredients a good raking, until all are fairly dissolved and well mixed.

Let this process be completed by 4 o'clock in the afternoon, and cover up the Vat for the night.

By 6 or 8 o'clock in the morning it ought to exhibit signs of springing, and you may rake up and let it rest until evening, then rake again and cover up for the night.

On the following morning try a lock of wool, and if this comes out a poor-looking Green, and turns in the course of a minute or two, into a thin, greyish Blue, the liquor at the same time looking of a dark blueish Green, it shows the want of a greater fermenting force. Give it a beer made as follows:

Take about 30 gallons of water (or you may take the same quantity of liquor out of the Vat) into a small kettle; put into it 5 quarts of bran, or 2 or 3 lbs. of hops, 2 quarts of molasses: boil these about one-half hour, taking care not to let it boil over; check the boiling, then put in 2 lbs. of Madder, and when all have settled, turn the whole into the Vat and rake up well.

In the evening rake again, when next morning it should be ready for coloring in.

But if, in the first instance, the trial sample comes out a tolerable Green and takes 3 or 4 minutes to pass to a blue, even if this should not be so good a shade as you expected, it shows that the materials are rightly proportioned and only require a little more time to produce their full effect. You will therefore rake up well, repeat the same in the evening, and next morning commence coloring. During all this time do not allow the heat to fall below 135 degrees.

ON THE MANAGEMENT OF AN ASH-VAT FROM DAY TO DAY DURING THE TIME OF COLORING IN IT.

You may color more wool at a time in an Ash-vat, than you can in one of Woad; because not having so great a body of sediment in it, the strainer or net may be suspended lower without touching the grounds.

The wool has to be treated in the operations of Dyeing in the same manner as for the Woad-vat.

After each coloring of wool, you will have to rake the Vat, and as this settles quickly (if it be in good order,) say in an hour, or an hour and a half, you can pass a greater quantity of wool through it in a day than can be obtained from the Woad-vat.

But you must be careful not to Dye in it so often as to tire and distress it, for in so doing you will lose more time in getting it into order again, than you have gained by the extra Dyeing you have done; independent of the expense of restoring it to a good working condition being much greater than what is necessary to keep it so when only a regular quantity of wool is colored daily.

(This case is particularly applicable to the Woad-vat.)

You must examine your vat of an evening after the Vat has reposed a couple of hours, to see whether it wants either Potash, or Madder and Bran.

If the liquor appears dark, or has a deep Blue Green cast, you must give Madder and Bran; or a beer made as above, which some Dyers prefer; if it is too open and the Indigo is not properly held in solution, you must serve the Potash.

In these two cases, the kind and quantity of the ingredients required, must be determined by your own judgment and experience, drawn from observations made on the appearance presented by the vat at the time.

After a day or two's work, the Vat will want a fresh quantity of Indigo to keep up its strength to the proper standard.

In giving it this, your object is to replace by a fresh supply, the quantity taken out by the wool that has been colored; and you will have to give along with this indigo, an equal weight of Potash; half as much Madder, and the same quantity of Bran, or you may use the clear liquor of a beer as before described, in quantity to suit your own discretion.

You will have to proceed so, from time to time, and these renovations you can make after every day's coloring, or at intervals of three or more days, suiting your own particular views in this respect; only bearing in mind to keep the Vat about one regular strength, and in good working condition: till such time as you want to work it out and set afresh, when you will cease giving it Indigo altogether.

I shall close this general outline of Dyeing wool Indigo Blue, by means of fermentation in a Vat, with a passing notice of a Vat or two of another description.

One of these is called the *Jack-Vat*, and partakes of the nature both of the Woad and the Ash-vat; having in its composition the ingredients peculiar to each; being set with about 150 lbs. of

Woad, 10 or 15 lbs of Potash, 8 lbs. Madder, 16 quarts of Bran, and 25 lbs of Indigo.

It is easier to work than the Woad-vat, but requires more skill and attention than the Ash-vat; in the course of running, it wants occasional supplies of Potash, Madder and Bran, with periodical renewals of Indigo, and 3 or 4 lbs. of *Ware* every 2 or 3 days is useful and necessary.

It does not produce so good or so fast a color as the Woad-vat, but it is superior to the common Ash Blue. This kind of Vat is chiefly used in Cotton-dyeing.

There is another mode of Dyeing Indigo-Blue by a Vat, the liquor of which is all stale urine (no matter of what size the vessel:) into this is put a sufficient quantity of Indigo to bring it to the usual strength of Blue Vats; with an equal quantity of Alum and Tartar and a small quantity of Madder and Bran.

This is kept at the temperature of about 100 degrees, when it naturally ferments in a few days, and the Ammonia serves as a solvent for the deoxydized Indigo.

Wool steeped in this from 24 to 48 hours becomes colored of a tolerable light blue.

This vat is only adapted to very small Dyeing establishments, and cannot be used for manufacturing purposes.

There is yet another mode of coloring Indigo Blue, which though the last in order of notice, is by no means the least either in utility or importance; it is that kind of a Vat called a Dye-Pot, which every frugal country house-wife has got set up in the corner of the kitchen fire-place, in which she colors every thing wanted for domestic purposes.

More anxious hours are spent over this Vat than all the others put together, and more mystery shrouds its processes than ever veiled the Sybiline oracles of old, for it is guarded with such vigilant care that the prying and curious eye of the professional Dyer can never obtain a single glance at it; and all the knowledge the latter have ever been able to obtain of its contents or composition is from observing by certain habits of some of the domestics that its principal ingredient must be Urine.

We infer it is very delicate to conduct; for it is said, that if the cover only be raised by the hand of an uninitiated one, or a single look be cast upon it by the optic of an envious rival, it is enough to *poison* it, and prevent its coloring any for a month afterwards.

It does not appear that there is any uniform plan of managing it, as every house-wife declares her way is the very best way; her dye-pot the best dye-pot, and her colors the best and *fastest* Indigo-Blues that ever were dyed.

This being all the knowledge I have of this mysterious process I am prevented from making it public, and must therefore dismiss it without further observations; and with it wind up this account of all the known processes of dyeing an Indigo-Blue, as the old wives say, *that will not fade.*

KETTLE BLUES.

SAXON-BLUE.

The material employed in producing this color is the solution of Indigo in four times its weight of concentrated Sulphuric Acid. (See Sulphate of Indigo.)

The lighter shades of this Blue are rather fugitive, soon assuming, by exposing to the sun and air, a dead and greenish appearance; the deep shades are much more permanent, a full Blue requiring some length of time to injure it.

But the Saxon Blue however deep or well dyed, cannot be ranked among the fast colors.

Although this color cannot be employed on wool that has to be scoured, (it being entirely destroyed by the action of either alkalies or soap,) yet as there may, in rare instances, be a call for this Blue upon wool, for some peculiar purpose unconnected with scouring or fulling, I think it advisable on this account, as well as to keep up the Order of the Colors, to give a Prescription how to produce it:

Aggregate Process.

Super-Tartrate of Potash, 5 lbs.
Potash-Sulphate of Alumina, 2½lbs.
Nitro-Muriate of Tin, 1½ lbs.
Sulphate of Indigo, 3 to 5 lbs.

In this recipe, the strength of 1½ lbs. of Logwood may be substituted for the Cudbear, and the Sulphate of Indigo may be replaced by a corresponding quantity of Indigo-paste; otherwise called Extract of Indigo. The quantity of prepared indigo in either case must be proportioned to the depth of the pattern.

This color should be dyed off in about three-fourths of an hour's time, with gentle boiling, otherwise it may work flat and greenish.

PRUSSIAN-BLUE.

The splendid shade going by the name of Prussian-Blue, Royal-Blue, or Chinchinela, and in this country by that of Mazarine-Blue, is not very applicable to wool-dyeing (although it resists common fulling and scouring tolerably well;) nevertheless, the same reasons that induced me to give a prescription for Saxon-Blue on wool, also influences me in introducing a description of this color here, as its most proper place.

This color, which vies in beauty and splendor with Scarlet and the finest Yellows, is comparatively a recent discovery; and I claim for myself the honor (which at the time never was disputed) of first succeeding in producing it upon woolen cloth, and some of the witnesses are yet living who will attest to what I am going to say.

In 1818 there were accounts published of this color being then employed by the French Dyers on silk, and having also seen silk goods so dyed, I was struck with its beauty and richness, and became extremely anxious to discover a method of fixing it upon woolen fabrics.

For this purpose I labored and experimented with unwearied perseverance for two years, before I could produce any thing fit to offer in the market, till in the Summer of 1820 I succeeded (after numberless failures) in effecting my object. The color being so much superior in brilliancy to all other Blues, soon brought it into notice, and a high price was paid for it.

Now this was nine years prior to the time when Messrs. Marriot & Son and Messrs. Almon & Melon are asserted by Mr. Malony to have been the only men in England who dyed it, to his knowledge; when, as early as 1824 or 1825, the knowledge of it had leaked out, and there were several Dye-houses in Yorkshire that were coloring Broad-cloths of that color.

I suppose the above-named gentlemen were the first to color it on worsted goods; but it had been long in use in a few Dye-houses on Broad-cloths, years previous to their applying it to thin goods.

Although neither myself, nor others who after a while gained a knowledge of this color, produced it as perfect as it now is, yet it was sufficiently well executed to stamp a character upon it, and to influence public taste in its favor, becoming for some time the prevailing color, and ever since then it has been more or less in demand for such purposes as bright Blues are wanted for.

The composition of this color is Oxyde of Iron 7.7 and Prussic Acid 11.175.

None of the acids affect it, though cloth dyed with it, plunged into a solution of Nitric Acid, turns Green; but this is in consequence of the wool changing to Yellow, by the effects of the acid, the Blue remaining unaffected, of course making a Green. If it be well dyed, it improves by exposure to the sun and air, growing richer and deeper by age; it will also bear repeated washings with common hard neutral soap, without much injury to it; but Ammonia, the solutions of Soda, and Pot or Pearlash, act upon and entirely destroy it.

A little of these alkalies, first raising and improving it; a stronger dose, or a longer exposure to a weak one, causes it to assume a purple shade. It is now near a dissolution, and a very little more alkali serves to dissipate it altogether.

Exposure to the common vicissitudes of the weather and ordinary wear, proves it to be as permanent a color in these respects as can be dyed; but submitted to alkaline tests, the Prussic Acid (or coloring principle) is abstracted, leaving nothing but an Oxyde of Iron on the wool or cloth.

Alkaline or Nitric Acid tests, show the dissimilarity between this and all other Blues.

RECIPES FOR BLUE.

PRUSSIAN–BLUE.

FIRST METHOD.

I have taken this from my plan of Dyeing 100 yards of Broadcloth, for which it is better adapted than to wool.

Mordant Process.

Sulphate of Iron, 5 lbs.
Potash-Sulphate of Alumina, 2½lbs.
Super-Sulphate of Potash, 5 lbs.
Aqua-Fortis, 2½ lbs.

Enter at a 170 degrees, and run up to 200; stew 2 hours; then heave out the wool and wash well.

Dyeing Process—Fresh Bath.

Prussiate of Potash, 10 lbs.
Muriatic Acid, 5 lbs.

Enter at 140 degrees and bring up to 175 in half an hour; then give :—Sulphuric Acid, 2½ lbs.; then bring up to a boil, which continue for about 15 minutes.

Heave out the wool and wash well.

If you wish to bloom this color a little, you can do it as follows, by the

Heightening Process.

Fresh bath at 120 degrees—dissolve in this bath,

Sal Soda, 1½ lbs.
Muriate of Ammonia, 1½ lbs.

Work in this liquor one-half an hour; then heave out and wash well.

PRUSSIAN BLUE.

Second Method.—Aggregate Process.

Prussiate of Potash, 10 lbs.
Muriatic Acid, 5 lbs.
Logwood (extract of,) 5 lbs.

Enter at 140 degrees, then run up the heat to 175, and add, of a saturated solution of Sulpho-Muriate of Tin, 3 pints.

Now run up to a boil, which continue about 15 minutes; take out and wash off well.

In some instances, an ounce or two of Bichromate of Potash is serviceable, given at the time the ebullition commences.

You will work the wool with levers during the whole time of Dyeing these Colors, in the same manner as for Madder Reds.

CHROME-BLUES.

Dyeing Process.

Bichromate of Potash, 1½ lbs.
Super-Tartrate of Potash, 1½ lbs.
Potash-Sulphate of Alumina, 3 lbs.

B oil one hour.

Dyeing Process.

Logwood (chipped,) 24 lbs.

Boil one hour.

ANOTHER.

Mordant Process.

Bichromate of Potash, 1 lb.
Crystalized Muriate of Tin, 1 lb.
Oxalic Acid, 1 lb.

Boil one and a half hours.

Dyeing Process.

Logwood (chips,) 16 lbs.
Hypernic wood, 8 lbs.

Boil three-fourths of an hour.

COMMON LOGWOOD–BLUE.

This is so deceitful, fugitive and despicable a Blue, that it seems almost a breach against common honesty to perpetuate any method of coloring it.

Mordant Process.

Potash-Sulphate of Alumina, 9 lbs.
Super-Tartrate of Potash, 5 lbs.
Sulphate of Iron, 3 lbs.

Boil two hours and wash.

Dyeing Process.

Logwood, 25 lbs.
Urine, 6 gallons.
Boil one hour.

ANOTHER BLUE, which will resist acids:

Aggregate Process.

Logwood (chipped,) 20 lbs.
Potash-Sulphate of Alumina, 5 lbs.
Super-Tartrate of Potash, 2½ lbs.
Murio-Sulphate of Tin, 2½ lbs.

Boil one hour; then add Sulphate of Indigo until you rouse this Purple into a full Blue.

This color is of no use on wool that has to be fulled and scoured; but it is well suited for yarn and cloth.

CLOSING REMARKS ON ORDER-BLUE.

In concluding these observations on the Order of Blue Colors and in connection with them, I will, for the benefit of Dyers and Manufacturers, insert in this work, a quarterly and yearly account of the number and weight of Cotton Warps, Dyed Indigo Blue by me, in the years 1845–6, for the Otis Company, Ware village, Mass., with the quantity of Dyestuffs used; weight of colored warp obtained from every pound of Indigo used; and the expense of each item connected with the Dyeing of the same.

Although Cotton Dyeing forms no part of the subject matter of this treatise, yet as there is a great amount of Indigo Blue Dyeing on Cotton Warps in this country by hot Vats, I think the introduction of the following table may be of some value and interest to many parties concerned in Blue warp Dyeing, as it exhibits the current expenses of a year's Dyeing of that description of work, and serves as a Standard of the cost of Dyeing each warp, pound, or yard of cotton cloth when the whole warp is colored:

ANNUAL ACCOUNT OF DYEING,

For the Otis Company, from 1st April, 1845, to 31st March, 1846, both inclusive, as per Monthly and Quarterly Accounts, previously turned in:

TOTAL.

Quarter.	No. of Warps.	Weight in lbs.	Quantity of Indigo.	Proportion of Yarn to Indigo.	
1	773	32,048	680¼	47 1-9	1
2	516	22,760	531½	42 89-100	1
3	734	36,722	929	40	1
4	600	30,000	750½	40¼	1
	2623	121,530	2891¼	170¼	4

Then, 170¼ divided by 4 equal to 42 lbs. 10 oz, of Yarn from each lb. of Indigo.

Or, 121,530 divided by 2891¼ equal to 42.03 lbs. of Yarn from each lb of Indigo.

The mean of the two divisions gives 42 lbs., 5 oz. of Yarn to each lb. of Indigo for the whole year.

Expenses of Dyeing 121,530 *lbs. of Yarn, Indigo Blue.*

1st Quarter, - - - - -	$1400.00
2d " - - - - -	1107.60½
3d " - - - - -	1524.16½
4th " - - - - -	1333.36¾
Total Expenses of the year, -	$5,365.13¾

Then, if 121,530 lbs Yarn cost $5,365.14, 1 lb. will cost 4 40-100 cents; and allowing 4 62-100 yards to the lb., the cost per yard during the whole year will be 0.952 of a cent., or in other words 9½ mills.

QUARTERLY GENERAL ACCOUNT,

Of Dyeing for the Otis Company, from January 1*st*, 1846, *to March* 31*st, both inclusive:*

Months.	No. of Warps.	Weight in lbs.	Quantity of Indigo.	Proportion of Yarn to Indigo.	
January,	172	8,600	245½	35	1
February,	192	9,600	270	35½	1
March,	236	11,800	235	50 10-100	1
Total,	600	30,000	750½	120¾	3

Then, 30,000 divided by 750.50, and, and 120¾ divided by 3, give a mean quantity of 40 lbs. Yarn to 1 lb. of Indigo, as the yield of the whole Quarter.

Expense of Dyeing 30,000 *lbs. of Yarn.*

Items	Quantity.	Price.	Amount.
Indigo,	750½ lbs.	*a* 112½ cts.	$844.31¼
Madder,	75 lbs.	*a* 17½ cts.	13.12½
Lime,	450 lbs.	*a* 8s. 6d. per 300 lbs.	2.12½
Bran,	6 bush.	*a* 28 cts. per bush.	1.68
Potash,	400 lbs.	*a* 4¾ cts. per lb.	19.00
Pearlash,	100 lbs.	*a* 5 cts. per lb.	5.00
Woad,	500 lbs.	*a* 5 cts. per lb.	25.00
Labor of Dyeing, Drying, Sizing and Drying,			228.12½
Other contingent Expenses may possibly amount to			200.00
Total Expenses of Dyeing for the Quarter,			$1,333.36¾

Then, if 30,000 lbs. cost $1,333.36, 1 lb. will cost 4.44 cts. for this Quarter.

The foregoing table is a copy taken from the minutes of a Dye-house under my charge at the time specified, and I stand ready, at all times, to take charge of any Establishment, and guarantee the results as there laid down, as proof of the fidelity of its details.

SECONDARY CLASS OF COLORS.

I DENOMINATE this class of colors Compound, from being composed of any two of the Simple Colors; or Secondary, from forming the second rank in this mode of arrangement whether this be of the deepest or lightest shades of either one or the other of the uniting colors; for example, Cane color, Salmon, Scarlet Barree, (or the Flame-colored Scarlet,) are colors of this class, and are composed of different proportions of the two simple colors, Yellow and Red; sometimes the Yellow being predominant, and sometimes the Red.

So are all mixtures of Yellow and Blue; forming all the shades of Green from the lightest apple Green to the deepest Laurel; and again, colors formed from the union of Red and Blue; from Lilac to the Tyrian purple.

Thus we can only have as many Compound colors as the Simple colors can form unions with each other.

After this manner the Yellow forms two Compound colors; one by its union with the Red to form the Auroras: and then by uniting with the Blue, to form the Greens.

The Red also forms two Compound colors; one by uniting with the Yellow, to form the Auroras, and the other by its union with the Blue, to form the Violets, or Purple shades.

And the Blue reacts upon the Yellow, to form the Greens, and upon the Red to form the Violets.

ORDER–AURORA.

I SHALL begin a description of this Order, by dividing it into two branches; one, wherein the Yellow prevails over the Red, and the other wherein there is an excess of Red, and taking the Aurora proper as the dividing or medium line between the two branches.

The varieties of this Order are more numerous than those of any other, from the fact that the Yellow and Red coloring matters are far more abundantly distributed through nature than the Blue.

They all possess these common distinguishing features: the yellowest of them when compared with a Yellow, have a Red cast or shade to them; and the reddest may be known from any of the species of Red by having a Yellower or more jaundice-like appearance.

In Dyeing any of the colors of this Order, equally as much cleanliness and care is necessary as in Dyeing Yellow or Red, because they are produced from the same materials; are equally as bright colors; are just as liable to spot; and are as much subject to injury in the beauty of their color, from any dirty mixture in the ingredients or in the liquor.

You obtain the Yellow portion of the color with either Fustic, Quercitron, or Weld; and the Red part either from Camwood, Madder, Munjeet, Lac, or Cochineal; but you have to bear in mind that the brilliancy of the color mainly depends upon the *kinds* of Yellow or Red Dyestuff you employ.

Fustic and Camwood may, for instance, make an Orange good enough for Listing and common uses; but if you want one of the greatest beauty, you must use Quercitron and Cochineal; Quercitron and Lac; or Weld and the same Red Dyestuff,—and so on of the other materials, only keeping in mind that Camwood, Madder, and Munjeet do not give so brilliant a color as Lac or Cochineal, although a closer and more solid one; and Fustic not so bright a color as Quercitron or Weld.

All the Red Dyestuffs here named give a fast color, and the Yellow Dyestuffs one sufficiently so.

Wash out these colors after Dyeing, and let the Yellow or lighter shades be dried under cover, and the deeper and Redder shades in the open air.

BUFF.

Super-Tartrate of Potash, 5 lbs.
Quercitron, Bark, 1 lb.
Munjeet, 4 oz.
Nitro-Muriate of Tin, 5 lbs.

ANOTHER BUFF.

Super-Tartrate of Potash, 6 lbs.
Murio-Sulphate of Tin, 4 lbs.
Young Fustic, 4 lbs.
Munjeet, 8 oz.

SALMON OR FLESH COLOR.

Super-Tartrate of Potash, 3 lbs.
Murio-Sulphate of Tin, 5 lbs.
Young Fustic, 2 lbs.
Lac Dye, ¾ lb.

MELON.

Quercitron Bark, 2½ lbs.
Munjeet, 3½ oz.
Super-Tartrate of Potash, 1½ lbs.
Potash-Sulphate of Alumina, 3 lbs.
Nitro-Muriate of Tin, 2½ lbs.

CANE.

Quercitron Bark, 5 lbs.
Munjeet, 5 oz.
Potash-Sulphate of Alumina, 5 lbs.
Nitro-Muriate of Tin, 5 lbs.
Super-Tartrate of Potash 2½ lbs.

ORANGE.

Potash Sulphate of Alumina, 5 lbs.
Super-Tartrate of Potash, 2½ lbs.
Muriate of Tin, 5 pints.
Quercitron Bark, 33 lbs.
Munjeet, 2½ lbs.

In all the foregoing recipes for these Aurora shades, Lac or Cochineal, in proportionate quantities, may be substituted for Munjeet; but they do not make so true and solid a combination with the Yellow part of the color.

The best crop Madder is a far better substitute for Munjeet than either Lac or Cochineal.

NASTURTION.

Quercitron Bark, 25 lbs.
Lac Dye, 5 lbs.
Potash-Sulphate of Alumina, 2½ lbs.
Super-Tartrate of Potash, 5 lbs.
Murio-Sulphate of Tin, 8 pints.

AURORA.

Quercitron Bark, 20 lbs.
Lac Dye, 8 lbs.
Super-Tartrate of Potash, 8 lbs.
Murio-Sulphate of Tin, 8 lbs.
Potash-Sulphate of Alumina, 2 lbs.

INFERIOR ORANGE.—Chiefly used for Listing.

Fustic, 20 lbs.
Camwood, 10 lbs.

You may if you think proper, *sadden* with 2½ lbs. of Alum. The wool may remain in this color all night.

FLAME COLOR OF SCARLET BARRE

Young Fustic, 15 lbs.
Lac Dye, 12 lbs.
Super-Tartrate of Potash, 10 lbs.
Murio-Sulphate of Tin, 1½ lbs.

MOCK SCARLET.

Best Crop Madder, 15 lbs.
Lac Dye, 7 lbs.
Super-Tartrate of Potash, 8 lbs.
Nitro-Muriate of Tin, 10 lbs.

All the colors of this Order are dyed by the Aggregate Process, and with one hour's boil; they are then (being all *spirit* or acid colors) to be thrown out of the Kettle and thoroughly washed as soon as convenient.

ORDER–VIOLET.

VIOLET is the Second Order of the Compound or Secondary Class of Colors, and the range of its shades or Varieties runs from the lightest Puce to the deepest Purple. It embraces the Lilacs, Lavenders, Wines, Ruby, and every other color composed of Red and Blue only.

The articles employed in dyeing these colors, are, for producing the Red part, Cudbear, Peachwood, Hypernic wood, Nicaragua, &c., and Cochineal; and for giving the Blue portion, Logwood or Indigo.

For Dyeing these colors in the most permanent manner, Cochineal and Indigo must be used in such quantities as each particular color requires.

For coloring them on a cheaper plan, and for more common purposes and fabrics, Peachwood, Hypernic, &c., are taken, along with Logwood, for the deeper shades; and Cudbear and Logwood for the lighter colors.

Cudbear is generally used for Lilac and Lavender, either before or after dyeing the Blue part, in the Vat, and is then called a fast Lilac or Lavender; and although they answer and pass for such very well, yet they are not so permanent or beautiful as when a proportionate quantity of Cochineal is used, instead of Cudbear.

The mordants for the deep wood Color are Alum and Super-Tartrate of Potash; also, Bichromate of Potash, and occasionally a little Sulphate of Copper; and in some very dark shades, even a little Sulphate of Iron may be added to the Alum and Super-Tartrate of Potash.

A Purple—equally as beautiful and durable as that from Cochineal—may be made from Logwood, by employing as a mordant, Alum, Super-Tartrate of Potash, and Nitro-Muriate of Tin; but this is not adapted to wool that has to be scoured and fulled afterwards. It answers well for yarn, flannel and fulled cloth, or other fabrics that have no after process of manufacturing to go through.

After dyeing and washing, let these colors be dried; the fast ones in the open air, and those of a less permanent character in the shade.

PUCE.

Cudbear, 5 lbs.
Super-Tartrate of Potash. 2½ lbs.

Boil one hour.

For a deeper shade use 7½ lbs. Cudbear and 4 lbs. of Super-Tartrate of Potash.

LILAC.

Mordant Process.

Potash-Sulphate of Alumina, 5 lbs.
Super-Tartrate of Potash, 1½ lbs.

Boil two hours.

Dyeing Process.

Hypernic Wood, 5 lbs.
Logwood, 5 lbs.
Urine, 2½ gallons.

Boil one hour.

LAVENDER.

Mordant Process.

Potash-Sulphate of Alumina, 7 lbs.
Super-Tartrate of Potash, 2 lbs.
Bichromate of Potash, 1 lb.

Boil two hours.

Dyeing Process.

Logwood, 8 lbs.
Urine, 2½ gallons.

Boil one hour.

BLUE VIOLET.

Mordant Process.

Potash-Sulphate of Alumina, 10 lbs.
Super-Tartrate of Potash, 1½lbs.
Bichromate of Potash, 1½ lbs.

Boil two hours.

Dyeing Process.

Logwood, 12½ lbs.
Hypernic Wood, 4 lbs.

Boil one hour.

COMMON PURPLE

Mordant Process.

Potash-Sulphate of Alumina, 12½ lbs.
Super-Tartrate of Potash, 8 lbs.

Boil two hours, and leave the wool in all night; next day wash.

Dyeing Process.

Hypernic wood, 16 lbs.
Logwood (chipped,) 16 lbs.
Urine, 3 gallons.

Boil one hour.

FAST, OR TYRIAN PURPLE.

Woad to a Middle-Blue at one dip, (wash off well;) then dye up as follows:

Cochineal, 7½ lbs.
Super-Tartrate of Potash, 2½ lbs.
Nitro-Muriate of Tin, 5 lbs.
Potash-Sulphate Alumina, 3 lbs.

Boil one hour.

MAZARINE BLUE.

Woad to a Middle-Blue at one Dip; wash, and dye up as follows:

Logwood, 12 lbs.
Potash-Sulphate of Alumina, 8 lbs.
Super-Tartrate of Potash, 2 lbs.

Boil in the above three-fourths of an hour; raise the wool and give 5 lbs. Nitro-Muriate of Tin; return the wool, and boil half an hour; throw out and wash.

FAST WINE COLOR.

Camwood, 60 lbs.
Logwood, 10 lbs.

Boil two hours; then raise the wool, and add to the same liquor the following:

Super-Tartrate of Potash, 2½ lbs.
Sulphate of Copper, 2½ lbs.
Muriate of Tin, 5 lbs.

Re-enter the wool; boil one hour; take out, and when cooled well, wash off.

COMMON WINE COLOR.

Mordant Process.

Potash-Sulphate of Alumina, 12½ lbs.
Super-Tartrate of Potash, 3½ lbs.

Boil two hours, and leave the wool in all night; next day wash off.

Dyeing Process.

Hypernic wood, 30 lbs.
Logwood, 10 lbs.
Urine, 2 quarts.

Boil 1 hour.

COMMON MAROON, OR RUBY.

Potash-Sulphate of Alumina, 12½ lbs.
Super-Tartrate of Potash, 3 lbs.

Boil two hours, and leave the wool in all night; next day wash off.

Dyeing Process.

Hypernic wood, 33 lbs.
Logwood, 3 lbs.

Boil one hour.

✓ CHROME PURPLE.

Mordant Process.

Potash-Sulphate of Alumina 10 lbs.
Super-Tartrate of Potash, 3 lbs.
Bichromate of Potash, 2 lbs.

Dyeing Process.

Logwood, 56 lbs.
Muriate of Tin, 3 lbs.

Boil one hour.

ORDER--GREEN.

The pure or real Green is formed of equal parts of Yellow and Blue, and the artificial departure from these proportions constitutes the principal difference to be met with in this Order; for there is a great sameness or similarity in the Greens that are applied upon wool, both in their general appearance and the kind of materials employed in Dyeing them.

The Yellow part being given either with Fustic, Quercitron, or Weld, but chiefly with Fustic; and the Blue with either Indigo or Logwood; but mostly with Indigo.

The Mordants employed, are Alum, Sulphate of Copper, Sulphate of Iron, and in a few cases solutions of Crystals of Tin are used.

Weld and Indigo make some of the brightest and most permanent Greens; Quercitron and Indigo also make a very bright color; Quercitron having its Mordants principally of Solutions of Tin, and this salt being rather injurious to fulling, is, in consequence of this circumstance, only employed for particular and peculiar shades, and when a great body of rich Yellow is wanted.

Fustic is therefore the principal Yellow used in Dyeing Green; but as regards permanence, all these substances afford the Yellow part of the color of sufficient durability.

In some of the Invisible Greens, which are merely dark Blues, just perceptibly tinged of a Green shade, Madder may be used instead of Fustic, Weld or Quercitron; and may be saddened with a little Sulphate of Iron, to give it a *black* appearance when looking down upon it; or the Sulphate may be omitted altogether if the pattern to be colored to does not particularly require it.

In the generality of the Invisible and Dark Greens, a small quantity of Logwood is used along with the Fustic in filling up on an Indigo ground; which tends to save considerable Indigo, as well as to give the desired fullness to the color.

The Greens made entirely with Logwood and Fustic are not of course so permanent as when Indigo is used, but they are as durable as Olives, Browns, or Blacks; the shade of the Woad Greens will always have more of an Olive appearance than the Indigo Greens.

The following recipes on this Order of Colors, are in sufficient number and variety to give the wool Dyer an insight into the manner of doing all the shades necessary in that particular branch of coloring.

All these colors may be dried in the open air, or in the shade, as suits the convenience of the Manufacturer.

CHROME GREEN.

Mordant Process.

Bichromate of Potash, 1½ lbs.
Super-Tartrate of Potash, 1 lb.
Potash-Sulphate Alumina, 1 lb.

Boil one hour, and let the wool remain in all night.

Dyeing Process.

Logwood, (chips) 10 lbs.
Fustic, (chips) 20 lbs.
Urine, 1 gallon.

Boil one hour.

RIFLE GREEN.

Mordant Process.

Bichromate of Potash, 1½ lbs.
Super-Tartrate of Potash, 1½ lbs.
Potash-Sulphate of Alumina, 1½ lbs.

Boil two hours.

Dyeing Process.

Logwood, (chips) 12½ lbs.
Fustic, (chips) 12½ lbs.
Sulphate of Copper, 1 lb.

Boil one hour.

COMMON LOGWOOD GREEN.

Mordant Process.

Bisulphate of Copper, 5 to 7½ lbs.
Boil two hours.

Dyeing Process.

Logwood, 20 lbs.
Fustic, 25 lbs.

Work the wool in this for about half an hour, at about 180 or 190 degrees, then give three pails urine, and work well for another half hour.

COSSACK GREEN.

Mordant Process.

Bichromate of Potash, 1½ lbs.
Potash Sulphate of Alumina, 1 lb.
Super Tartrate of Potash, 1 lb.
Boil two hours.

Dyeing Process.

Fustic, 40 lbs.
Crop-Madder, 5 lbs.
Logwood, 7 lbs.
Sulphate of Copper, 1 lb.
Boil one hour.

This Green can be made perfectly fast by a very slight Woading.

WOADED GREENS.

RICH FULL GREEN.

Woad up to two-thirds full Blue, then wash well.

Dyeing Process.

Fustic, 90 lbs.
Crop Madder, 10 lbs.
Potash-Sulphate of Alumina, 10 lbs.
Sulphate of Copper, 2 lbs.

Boil one hour.

BOTTLE GREEN.

Woad to a middle Blue, then wash.

Dyeing Process.

Fustic, 50 lbs.
Logwood, 5 lbs.
Potash, 2½ lbs.
Potash Sulphate of Alumina, 2½ lbs.

Boil one hour.

INVISIBLE GREEN.

Woad to two-thirds full Blue; wash off well; then use in the

Dyeing Process.

Fustic, 10 lbs.
Logwood, 5 lbs.

Boil about half an hour; then Sadden with

Sulphate of Copper, 1 lb.
Sulphate of Iron, 1 lb.

Boil three-fourths of an hour.

ANOTHER METHOD.

Woad to a three-fourths full Blue, and wash.

Dyeing Process.

Crop Madder, 15 lbs.

Boil 1½ hours, then Sadden with 2 lbs. Sulphate of Iron, and boil one hour.

WELD GREEN.

Woad to two-thirds full Blue, or according to the shade of pattern.

Mordant Process.

Potash-Sulphate of Alumina, 10 lbs.
Bi-Sulphate of Copper, 10 ozs.
Super-Tartrate of Potash, 2 lbs.

Dyeing Process.

Weld or Woalds, 50 to 75 lbs.
Urine, 3 gallons.

BARK GREEN.

Woad to a middle Blue, or according to shade of pattern.

Quercitron Bark, 10 or 15 lbs.
Potash-Sulphate of Alumina, 5 lbs.
Super-Tartrate of Potash, 2½ lbs.
Murio-Sulphate of Tin, 2½ lbs.

Boil one hour.

INTERMEDIAL CLASS OF COLORS.

It is perhaps useless to introduce a Class of Colors under the above head into a Table professing to be founded on natural Distinctions, as no such insubordinate distinctions exist in nature, for it is perfectly plain that the Fawns, Drabs and Slates are only Browns, Olives and Plums, *weakened* by being spread or extended through a greater space than they occupied in the original state of Browns, Olives and Plums, and the Lead colors are only Black, attenuated through the same cause; in other words, the Fawns, Drabs, Slates and Leads, are only the Browns, Olives, Plums and Blacks, whose molecules or ultimate particles are separated by wider interstices, or are removed from one another by greater spaces than in the original colors from which they are derived; but let us prove this remark by actual experiment: let us make up a color of any order of the Tertiary Class of Colors, say Olive; and let this be for woolen-printing, and the quantity one gallon: now, in order to obtain any and every shade of Drabs, we have only to reduce the strength of our Color by the addition of 4, 8, 12, or any other number of gallons of water, (or of gum water,) and we shall certainly effect our object: and in order to get an Olive from a Drab Color, we have only to evaporate the 4, 8, or 12 gallons of liquid, of which it is composed, down to one, when we have the original Color reproduced and unaltered.

What is proved of this Color applies equally to all others, and it leads us directly to a positive fact of the greatest practical utility in Topical printing; viz., that by making Yellow, Red and Blue, Standard Colors, we can produce every Color and every *shade* of Color under heaven; by mixing the Primitive Colors in their proper proportions, we have all the Colors that can be derived by their various unions; and by reducing these with gum water, we obtain all the light shades belonging to them.

There would also result another advantage from using the three Primitive Colors as Standards to produce all the others from, which would be this: there would be one uniformity of shading, or rather one certain and equal degree of brightness in every color of which the pattern was composed. There could be no dull Orange and bright Yellow and Blue, nor dull Green where the Blue and Yellow were equally bright, &c. &c.; whatever the brightness of the three Standard Colors were, one harmonious shade of lustre would pervade all the Colors derived from the original Standards: no clashing of dull and bright colors, as we see must inevitably be the case where each color is made up separately and of the most dissonant materials.

These observations will tend to show that there is no *Natural* Class of Colors resulting from fresh combinations of Colors, other than are laid down on page 176; that is, there are only four Classes; and my only reason for a separate Classification of the Fawns, &c., is that their delicacy of shade, requiring great nicety and care in producing them, calls for the particular attention of the Dyer to the description of the methods employed to obtain these Colors, and the manner of varying their shades; and that this attention would be more forcibly arrested by making a distinct article of them, has been the cause why I have separated the treatise on them from the Class of Colors to which they unquestionably belong.

They form a portion of that numerous body of Colors to which Wool Dyers very appropriately give the name of "Saddened Colors." The Prescriptions for producing these Colors are arranged under the headings of Minor Shades of Brown, Plum and Olive.

ORDER–BRONZE.

I HAVE named this the Intermedial Class of Colors, because it is in the midst or between the two extremes of Black and White. It is formed by the simple union of the three Primitive Colors, and includes in its Species and Varieties all the Fawns, Drabs and Lead Colors; these being mere varieties of the Bronze.

With this Order commences all those Colors which are denominated, in Wool Dyeing, *Saddened Colors;* viz: Fawns, Drabs, Leads, Browns, Plums, Olives and Blacks: none of these shades are given by the Prism, or observed in the rainbow.

In Dyeing any of the Colors of this Class upon wool, the principal ingredients are Camwood, Cudbear, Madder, Fustic, Shumac, Nut Galls and Logwood; and the Mordants or saddening articles, chiefly Sulphate of Iron, Alum, Tartar, and rarely Sulphate of Copper; but owing to the lightness and variety, both in the shades and the materials to be employed in coloring them, no definite quantity of any of the materials can be fixed upon, as producing, at all times, and under all circumstances, the same particular shade of Fawn, Drab or Lead.

Therefore, the Dyer, in working up these Colors, has to depend more upon his judgment for the quantity and kind of articles necessary to produce a given effect, than in any other Color whatever.

All the information that can be given respecting Dyeing these shades amounts to mere generalities; one of which is, to be certain to begin coloring with little enough Dyestuffs; for more can be given if wanted; but if the quantity required by the pattern be exceeded, it will be rather a bad business to work it off again.

If it happen not to be brought up to the pattern by the first quantity of materials, give it more, and of such sorts as, by a comparison with the pattern, you ascertain to be needed: if it requires to be made redder, only Camwood must be given; if redder and bluer, Cudbear, and perhaps a little Logwood, or a trifle more saddening may be used; if it be short of Yellow, give it Fustic; but remember always to leave them a little under the pattern in this respect, as the Yellow always rises in a Fawn or Drab, and the

Red does some, also, especially Camwood; always leave them when finished a little on the saddened side of the pattern.

If they are not Blue enough, give a little Logwood, or Sulphate of Iron, according to your own judgment; if not Green enough, perhaps a little Shumac may give it that hue, or Shumac and Sulphate of Iron together.

In all these cases, the shades given by the Dyestuffs are: Cudbear, a *blueish* Red; Madder, a *yellowish* Red; Camwood, a Red with less Yellow in it than Madder; Fustic gives the Yellow; Shumac, a greenish Yellow; Nut Galls, darken; and Logwood blues up well; so, by keeping in mind the cast of shade that each kind of Dyestuff (along with the effect of Saddening) gives, will aid the Dyer very much in his choice of materials when Dyeing, or filling up these colors.

But, as before said, experience and judgment in the Dyer are what is essentially necessary to the production of any pattern of this Order of Colors; for it is impossible to give recipes for any of these shades, that will at all times and in all places produce precisely the same effects; for there are so many circumstances which go to affect the shades of such colors, that it is impossible to foresee them, or provide in prescriptions against every contingency.

These kinds of colors may mostly be Dyed either by using all the Dyestuffs and the Saddening together, or by first boiling on the Dyestuffs, and then Saddening afterwards.

The recipes attached will give the Dyer a sufficient idea how to make the necessary variations in Dyeing to different Patterns.

All these colors may as well be dried in doors.

Minor Shades of Brown.

FAWN.

Catechu, 3 lbs.
Fustic, 1½ lbs.
Boil one hour.

SALMON FAWN.

Super-Tartrate of Potash. 2 lbs.
Fustic, 2 lbs.
Camwood, 4 lbs.
Boil one hour and a half.

ANOTHER FAWN.

Crop Madder, 2 lbs.
Camwood, 2 lbs.
Fustic, 2½ lbs.

Boil one hour and a half, then sadden with half a pound of Sulphate of Iron, and one half hour's boil.

SANDY FAWN.

Madder, 2 lbs.
Camwood, 2 lbs.
Fustic, 2 lbs.

Boil one hour and a half, and sadden with 8 oz. Sulphate of Iron and 2 oz. Potash Sulphate of Alumina and half an hour's boil.

ESTERHAZY FAWN.

Cudbear, 2 lbs.
Camwood, 2 lbs.
Fustic, 2 lbs.
Logwood, 4 oz.

Boil one hour and a half, then sadden with ½ lb. of Sulphate of Iron, and boil half an hour.

CHOCOLATE FAWN.

Cudbear, 3 lbs.
Camwood, 1 lb.
Fustic, 3 lbs.
Logwood, 4 oz.

Boil 1½ hours; then sadden with ¾ of a lb. of Sulphate of Iron, and boil half an hours' boil.

NUT-SHELL.

Madder, 1 lb.
Fustic, 2 lbs.
Camwood, 3 lbs.

Boil 1½ hours: then Sadden with ⅓ lb. Sulphate of Iron, and half an hour's boil.

HARE-BACK.

Fustic, 3 lbs.
Camwood, 3 lbs.
Madder, 6 lbs.

Boil 1½ hours; then Sadden with ¾ lb. Sulphate of Iron and ¾ lb. Sulphate of Copper, and half an hour's boil.

MULE COLOR.

Crop Madder, 1 lb.
Camwood, 1 lb.
Nut Galls, 1 lb.

Boil 1¼ hours; then Sadden with ¾ lb. Sulphate of Iron, and half an hour's boil.

Minor Shades of Plum.

LEAD.

Logwood, 10 lbs.
Potash-Sulphate of Alumina, 1¼ lbs.
Sulphate of Iron, 2¼ lbs.

Boil an hour.

ANOTHER METHOD.

Is to take the above quantity of Logwood; boil one-half hour; then Sadden, as in the recipe, with half an hour's boil.

ANOTHER LEAD.

Logwood, 9 lbs.
Camwood, 3 lbs.

Boil 1½ hours; then Sadden with 1½ lbs. Sulphate of Iron, and half an hour's boil.

SLATE.

Logwood, 8 lbs.
Shumac, 2 lbs.
Fustic, 2 lbs.
Madder, 2 lbs.

Boil 1½ hours; then Sadden with 2 lbs. Sulphate of Iron, and half an hour's boil.

DRAB SLATE.

Logwood, 16 lbs.
Camwood, 2 lbs.

Boil 1½ hours; then Sadden with 4 lbs. Sulphate of Iron and three-fourths of an hour's boil. This color to mix with Puce for Slate mixture.

LONDON SMOKE.

Logwood, 10 lbs.
Fustic, 10 lbs.
Camwood, 2 lbs.

Boil 1½ hours; then Sadden with 3 lbs. of Sulphate of Copper and 6 lbs. Sulphate of Iron, and three-fourths of an hour's boil.

Minor Shades of Olive.

PEARL DRAB.

Logwood, 1½ lbs.

Boil one hour, then Sadden with ½ lb. of Sulphate of Iron and one half hour's boil.

SILVER DRAB.

Fustic, 14 oz.
Madder, 4 oz.
Super-Tartrate of Potash, 1 lb.
Sulphate of Iron, ½ oz.

Boil 1½ hours.

DRAB.

Fustic, 1½ lbs.
Madder, 1½ lbs.
Logwood, ¾ lb.
Shumac, ¾ lb.

Boil 1½ hours; then Sadden with 3 oz. of Potash-Sulphate of Alumina, and 6 oz. Sulphate of Iron; half hour's boil.

STONE DRAB.

Catechu, 3 lbs.
Logwood, 3 oz.

Boil one hour; then Sadden with ¾ lb. of Sulphate of Iron; one half hour's boil.

STONE DRAB.

Logwood, 4 oz.
Fustic, 2 lbs.
Shumac, 2 lbs.
Madder, 1 lb.,
Camwood, ½ lb.

Boil one and a half hours; then Sadden with 4 oz. of Potash Sulphate of Alumina and 8 oz. Sulphate of Iron; boil half an hour.

BANG-UP DRAB.

Fustic, 2 lbs.
Camwood, ½ lb.
Madder, 4 lbs.

Boil one hour; then Sadden with 1½ lbs. Sulphate of Iron, and half an hour's boil.

SAGE DRAB.

Logwood, 1 lb.
Fustic, 3 lbs.

Boil one and a half hours, and Sadden with 1 lb. Sulphate of Iron and ½ lb. Sulphate of Copper, with three-fourths of an hour's boil.

FAST SAGE.

First, Woad to the lightest possible shade of Blue (or French Gray) and wash; then give:

Fustic, 6 lbs.

Boil one hour; then Sadden with 1 lb. of the Sulphate of Iron and 1 lb. of Sulphate of Copper, and three-fourths of an hour's boil.

OLIVE DRAB.

Logwood, 22 oz.
Fustic, 6 lbs.
Madder, 3 lbs.

Boil one and a half hours; then sadden with ¾ lb Sulphate of Iron and ¼ lb Sulphate of Copper, and three-fourths of an hour's boil.

ESTERHAZY DRAB.

Catechu, 2 lbs.
Camwood, 5 lbs.
Cudbear, 1 lb.

Boil 1½ hours; then Sadden with 1 lb. Sulphate of Iron, and one half an hour's boil.

TERTIARY CLASS OF COLORS.

THIS Class of Colors are obtained by the union of three Simple colors with each Order of the Secondary Class, separately; that is by taking the Bronze, (which is the aggregate of the Primary Colors, and adding the Aurora to it, gives the Brown;)—Bronze and Violet, the Plum; and Bronze and Green, the Olive.

Thus we get three Grand Divisions, following in the hue of their shades the primitive colors from whence they are derived, and partaking more or less of the Yellow, Red or Blue shades, in proportion to the excess of any of these colors over the other in the composition of the Tertiary Color:—the Yellow and Red prevailing over the Blue in the composition of the Brown; the Red and the Blue prevailing over the Yellow in the composition of the Plum; and the Blue and Yellow are in excess over the Red in the composition of Olive.

These colors can always be made perfectly fast and durable, if expense and care be taken to give them the Blue part in the Vat, instead of the usual method of Logwood and Saddening; the Yellow and Red parts being obtained from Fustic, Madder, Camwood &c., which yield permanent colors.

However, the common plan of Dyeing the Plum and Olive, with Logwood, &c., affords these colors sufficiently fast for most purposes.

These colors are generally reported to make the wool more harsh and tender, and worse to work than any other colors; and this effect is usually attributed to the Sulphate of Iron; but this is a great mistake, for there is less Copperas used in some Browns than in some Drabs, and yet the Drabs always work well.

If there be any real foundation for these reports, the effect must be owing to the particular kinds and great quantity of Dyestuffs necessarily employed in producing these deep colors.

We know that Fustic, Shumac, and even Logwood, (independent of the coloring matter peculiar to each kind of Dyestuffs,) contain considerable Tannin, as well as Extractive matter; and again, Camwood, Barwood, and Sanders are hard resinous woods, and give to their watery extracts a harsh and brittle property or substance,

The Salts employed as Mordants or Saddening, such as Alum, Sulphate of Iron, Sulphate of Copper, &c., also exercise considerable action upon wool; so no great wonder, if from a combination of all these causes, a quantity of wool exposed for three hours in a boiling solution should be a little affected thereby; (whether it be so or not the effects are unavoidable: for the above articles and in sufficient quantities *must* be employed to produce the color,) but by using common prudence in the management of the wool in the Kettle, and in proportioning the mordants to the quantity of Dyestuffs used, every thing that can be attributed to the unskillfulness of the Dyer may be avoided.

But there is sometimes more outcry, (especially by bad Carders) about tender wool, than there is occasion for, even when they have a Dyer with little or no skill or experience; I never knew or heard tell of a good Carder making complaints about tender colors; but I have known a bad Carder make horrible tender work of White wool; and and we all know that if it gets well Carded there is no after trouble about working it.

ORDER BROWN.

THE constitution of this Order is Bronze and Aurora.

In the Dyeing of Browns, the principal part of the Dyestuffs are Fustic and Camwood, Barwood or Madder; it is necessary to boil these articles well before entering the wool; because they give out their coloring matter much slower than Logwood, and they require to be well combined with the wool before commencing to Sadden, as the Camwood, Barwood, or any of the hard resinous woods, will not give out any more color, after Copperas, &c., is thrown into the kettle; but Fustic continues to give body during the whole time of coloring.

They are mostly dyed by the process of Stuffing and Saddening, and as some of them require very little Sulphate of Iron, or Sulphate of Copper to Sadden them, which could not be thrown on in the crystalized state so as to darken the color evenly, it will be best to dissolve the mordant in a few pails of the hot Dye Liquor, and then throw on a little by degrees so as to get the wool evenly imbued with it.

Some Dyers use Crude Tartar in these kinds of colors along with the Dyestuffs, but I never make use of that article for any of the saddened colors upon wool, except such as I prepare or mordant before finishing with the Dyestuffs; I consider Argol (Crude Tartar) not only unnecessary, but absolutely injurious, where Camwood, Barwood, Sanders, &c., are used; and the only cases in which it can be of any service in Browns, &c., is where Madder and Fustic are the only Dyestuffs employed for light colors, such as Cinnamon and light Snuff.

In Dying to Pattern it should be remembered that the Yellow and Red always rise in the after processes of manufacturing, and the darkening impairs or looses; consequently they should be left rather darker and a little shorter of Red and Yellow than the Pattern.

For Chrome Browns, or such as are prepared with a Mordant of

Bichromate of Potash &c., the hard resinous Woods should not be employed, as their coloring matter will scarcely attach itself upon this or any other Mordanted wool; the little that does combine, strikes very unevenly and of a poor, wretched hue:—they are therefore of no use in this case, and the principal coloring matters employed in this color when prepared with Chrome, &c., should be Fustic and Madder with a little of the most permanent of the soft Red Dye Woods.

CINNAMON BROWN.

Fustic, 5 lbs.
Camwood, 30 lbs.
Madder, 10 lbs.
Boil two hours.
Sulphate of Copper, 2 lbs.
Sulphate of Iron, 1 lb.
Boil one hour.

GOLDEN BROWN.

Dyeing Process.

Fustic, 65 lbs.
Madder, (crop) 6 lbs.
Boil two hours.

Mordant Process.

Sulphate of Iron, 1 lb.
Boil one hour.

SNUFF BROWN.

Dyeing Process.

Fustic, 50 lbs.
Madder, 10 lbs.
Camwood, 7 lbs.
Boil two hours.

Mordant Process.

Sulphate of Iron, 1½ lbs.
Boil one hour.

RUSSEL BROWN.

Dyeing Process.

Fustic, 50 lbs.
Camwood, 50 lbs.
Hypernic Wood, 10 lbs.
Boil two hours.

Mordant Process.

Sulphate of Iron, 2 lbs.
Sulphate of Copper, 1 lb.
Boil one hour.

OHIO RROWN.

Dyeing Process.

Fustic, 50 lbs.
Crop Madder, 12½ lbs.
Camwood, 5 lbs.
Boil two hours.

Mordant Process.

Sulphate of Iron, 1 lb.
Boil one hour.

OLIVE BROWN.

Dyeing Process.

Fustic, 35 lbs.
Camwood, 15 lbs.
Madder, (mull) 10 lbs.
Logwood, 3 lbs.
Boil two hours.

Mordant Process.

Sulphate of Iron, 1½ lbs.
Boil one hour.

COFFEE BROWN.

Dyeing Process.

Fustic, 25 lbs.
Camwood, 25 lbs.
Madder, (common,) 12½ lbs.
Boil two hours.

Mordant Process.

Sulphate of Iron, 2 lbs.
Sulphate of Copper, 1 lb.
Boil one hour.

A CHROME BROWN.

Mordant Process.

Bichromate of Potash, 2 lbs.
Bisulphate of Copper, 1 lb.
Boil one hour.

Dyeing Process.

Fustic, 30 lbs.
Hypernic Wood, 15 lbs.
Logwood, 1 lb.
Boil one hour.

ORDER-PLUM.

THE Plum shades may be supposed to include the Claret, Mulberry, Adelaide, and all others bearing upon a Purple hue and that cannot be ranked as Browns, not having Orange enough in their composition; nor yet styled Olives, because lacking the Green; the composition of Plum being the Bronze and Violet.

They are a species of color much used for Broadcloth. The materials employed in dyeing them are generally such as give durable coloring-matter; being Camwood, Barwood, Sanders, Madder, and sometimes, in order to get an extra richness at a small cost, (but at the expense of the character of the color for durability,) Nicaragua or Hypernic wood is used.

However, they are, even when colored with Logwood, Camwood, &c., as kettle-colors only, sufficiently lasting to warrant manufacturers making considerable of them in that way; but all doubt respecting their permanency is removed when they are blued in the Vat, and then filled up with Camwood, &c., afterwards.

What has been said of the Browns, respecting being harsh and tender to work, applies, for like reasons, in some measure, to these colors; and if there be more reality than conceit in the report, it is unavoidable, and we have to put up with it, until such time as something can be discovered that will produce these deep colors without producing such effects.

In Dyeing these colors so as to avoid, as much as possible, these effects, be cautious in the use of the Mordants or Saddening part, giving them no more than is absolutely necessary to produce the wished-for effect, neither suffering them to boil longer than needed in the Saddening.

Let them be washed and dried in the open air, although too much sun renders all dark-colored wool harsh and brittle.

In coloring these shades to Pattern, leave them on the Bluer or darker side of it, as the Red rises considerably.

CLARET.

Dyeing Process.

Camwood, 65 lbs.
Logwood, 10 lbs.
Boil two hours.

Mordant Process.

Sulphate of Copper, 5 lbs.
Sulphate of Iron, 1 lb.
Boil one hour.

MULBERRY.

Woad to a middle Blue, then wash off well.

Dyeing Process.

Camwood, 30 lbs.
Hypernic, 10 lbs.
Logwood, 5 lbs.
Boil two hours.

Mordant Process.

Sulphate of Copper, 5 lbs.
Sulphate of Iron, ¾ lb.
Boil one hour.

ADELAIDE.

Woad to two-thirds Blue; then wash well.

Dyeing Process.

Camwood, 15 lbs.
Hypernic, 5 lbs.
Logwood, 2½ lbs.
Boil one hour; then raise the wool, and give in the

Mordant Process.

Cochineal, 2½ lbs.
Potash-Sulphate of Alumina, 2½ lbs.
Super-Tartrate of Potash, 1¼ lbs.
Nitro-Muriate of Tin, 2½ pints.

Boil three-fourths of an hour.

PERUVIAN.

Mordant Process.

Potash-Sulphate of Alumina, 8 lbs.
Super-Tartrate of Potash, 2 lbs.
Sulphate of Copper, 2 lbs.
Crystalized Muriate of Tin, 1 lb.

Boil two hours.

Dyeing Process.

Logwood, 36 lbs.
Hypernic wood, 12 lbs.
Madder, 12 lbs.

Boil three-fourths of an hour; then darken with about 1 lb. of Sulphate of Copper, and one-half an hour's boil.

CHOCOLATE.

Dyeing Process.

Sanders, 16 lbs.
Fustic, 10 lbs.
Logwood, 12 lbs.

Boil two hours.

Mordant Process.

Sulphate of Copper, 4 lbs.
Sulphate of Iron, 2 lb.

Boil 1 hour.

CORBEAU.

Dyeing Process.

Camwood, 25 lbs.
Logwood, 25 lbs.
Fustic, 2½ lbs.

Boil one hour.

Mordant Process.

Sulphate of Iron, 5 lbs.
Sulphate of Copper, 1 lb.

PLUM.

Dyeing Process.

Camwood, 20 lbs.
Logwood, 30 lbs.

Boil 1½ hours.

Mordant Process.

Sulphate of Iron, 3 lbs.
Sulphate of Copper, 3 lbs.

Boil one hour.

ORDER–OLIVE.

OLIVE is the effect of the union of Green and Bronze, and its prime proportions are, 1 Red, 2 Yellow, and 2 Blue.

It is a handsome dark color when well Dyed, but nothing looks meaner than it does, if it be left thin, meager, and destitute of lustre. Therefore, in coloring the Olive shades, give considerable latitude in the use of the Dyestuffs, and get the wool thoroughly impregnated with their solution before attempting to Sadden.

In Dyeing common Olives, Fustic, Logwood, and Madder are used, and by some Dyers, Camwood. This last may be useful, along with Madder, in some very brown Olives; but yet Madder is preferable, because it gives a much richer and more intense color.

Proportion the Saddening according to the quantity of Logwood used; say about one-seventh of Sulphate of Iron to 1 lb. of Logwood.

In some shades, a little Urine may be added, after Saddening, and when the boil is about ceasing.

In Dyeing the True or Fast Olives, a light Blue (in depth according to pattern) is given in the Vat; they are then filled up with Fustic, Madder, or a little Logwood, and then Saddened. This method gives much brighter and richer, and of course more permanent colors than when Logwood alone is used to give the Darkening.

In coloring to Pattern, leave them on the *greener* side of it, as the Yellow and Red rise in the process of manufacturing; the Red more especially, if Camwood or Barwood has been used.

Dry them either in the open air or under cover.

TEA COLOR.

Dyeing Process.

Fustic, 70 lbs.
Madder, 5 lbs.
Logwood, 2½ lbs.

Boil two hours.

Mordant Process.

Sulphate of Iron, 2 lbs.
Sulphate of Copper, 1 lb.
Boil one hour.

GREEN OLIVE.

Dyeing Process.

Fustic, 30 lbs.
Logwood, 20 lbs.
Boil two hours.

Mordant Process.

Sulphate of Iron, 2¼ lbs.
Boil one hour.

CHROME OLIVE.

Mordant Process.

Bi-Chromate of Potash, 2 lbs.
Potash-Sulphate of Alumina, 1 lb.
Super-Tartrate of Potash, 1 lb.
Boil two hours.

Dyeing Process.

Fustic, 20 lbs.
Logwood, 15 lbs.
Madder, 5 lbs.
Boil one hour.

BROWN OLIVE.

Dyeing Process.

Fustic, 50 lbs.
Crop-Madder, 12½ lbs.
Logwood, 7 lbs.
Boil two hours.

Mordant Process.

Sulphate of Iron, 2½ lbs.
Boil one hour.

TRUE OLIVE.

Woad to a very pale Blue, then use in the.

Dyeing Process.

Fustic, 42 lbs.
Madder, 8 lbs.
Boil two hours.
Sulphate of Iron, 2 lbs.
Sulphate of Copper, 1 lb.
Boil one hour.

AGGREGATE CLASS OF COLORS.

ORDER–BLACK.

I CONSIDER Black as containing within itself all the other colors; consequently I call it the Aggregate; or, supposing a mixture to be made of all the different Colors I have described, from the Yellow to the Olive inclusive; the result of this amalgamation would be Black; it must therefore contain in its composition as many proportions of the Original colors as these have been taken separately to form the whole number of colors that compose the Black.

Jet Black then, is a something that we perceive when the whole mass of colors composing it are so evenly balanced that none of the Primitive, Secondary, or Tertiary Class of Colors are reflected more than another; or in other words, there is a perfect neutralization, in this case, of *all* the colors; the Primitive ones and their combinations being all there, but none of them individually perceptible on account of one shade counterbalancing another.

From these observations my ideas respecting colored bodies, (whether artificially or naturally colored,) may be gathered; viz., that all colored or White substances retain or absorb all and every of the colored solar rays; while Black reflects or sends back to the eye every ray of colored light, and suffers none to be condensed in the body of the substance reflecting those rays; and as to substances giving other colors than Black and White, it is to be supposed that they possess the power of absorbing some rays and reflecting others; for instance, I conclude that any Yellow substance absorbs the Red and the Blue rays, and reflects only the Yellow; and so on of all the others; either Simple, Compound, or Triple coloring substance that they transmit or reflect all the colors exhibited to the eye, and absorb or retain the peculiar ray or rays which does not enter into the composition of the color perceived.

In old times it was the universal practice or method of Dyeing Black, to give it three separate Dyeings;—with Madder, Indigo and Weld; laying on by three different processes, the Primary Colors in such quantities as were sufficient to produce a Black, and on the judicious proportioning of these colors depended the beauty of the Black color.

As they used in this case nothing but materials that afford the Yellow, Red, and Blue of the most permanent kind, it is easy to see, by a comparison of this mode of Dyeing with any of the present plans for producing fast Blacks, that we have no method now in use that will equal it in point of beauty and durability.

But Dyers having been compelled by the public rage for cheap articles to lay aside these expensive processes, are not blameable if their colors do not now possess the same degree of permanence that distinguishes those of ancient times; because for this reason, they have been necessitated to make fewer and shorter processes and cheaper kinds of Dyestuffs their main study in endeavoring to meet the demands of a vitiated taste.

Therefore in the Dyeing of Black for mixtures and common purposes, they have recourse to Logwood, and Sulphate of Iron, with perhaps a little Shumac, as materials of the least cost; and they apply these to the wool by the process of Stuffing and Saddening, as a method calculated to fix them most permanently, and at the same time economize labor, time and fuel.

But there are Blacks that are wanted for more particular purposes, or that have to be exposed to severer tests of their permanence, which makes it necessary to adopt a little more expensive materials, and different processes, in order to obtain superior colors.

In this case, the Process of preparing and Finishing becomes expedient; which is performed by boiling the wool for two hours in a solution of such Chemical Salts as are required to form the basis of the color; to which is given the name of Mordant, and to the process itself the term Mordanting or Mordanted; the wool remains in this solution all night, the boiling having been suspended after two hours.

In the morning, the Mordanted wool is taken out of the kettle, and after having drained well, is entered into the Finishing Liquor; which is made of Logwood, &c., in clear water. The wool boils in this about one hour, when it is taken out as soon as convenient, and washed or not, as may be required, and then dried.

The colors produced by this process (even from the same materials) are supposed to be more beautiful and permanent than by the process of Stuffing and Saddening, and the wool is more open and works better, as a general thing; but it is more expensive than the latter mode of Dyeing.

For Blacks that have to be dyed up on the finest kind of wool, and have afterwards to be manufactured into black cloth, and must be warranted in the market as fast colors, more expensive materials than the above have to be employed; therefore, in this instance, the wool is first Dyed in the Vat of a lighter or deeper Blue, according as the owner of it concludes a more or less permanent color will be most profitable to him.

After Dyeing in the Vat, it is washed, and then, as a general thing, filled up with Logwood, and perhaps some Fustic or Shumac; then Saddened.

Another method of making Fast Blacks, is—first to give them a good, deep bodying of Madder—or it may be done with Fustic and Camwood—and then Dyed in the Vat until deep enough. This method requires more Indigo than the preceding, and of course is more expensive than where Logwood is used as a help in filling up the Blacks; but it is more permanent, works better and feels softer than where Logwood and Sulphate of Iron form part of the color.

I have given the prescriptions for producing both the Blue-Black and Jet-Black, by all these different plans and ingredients.

It is not good to dry up Black too much, either by the sun or fire, as it has a tendency to make it hard to work, and cause it to feel harsh and ungrateful to the touch. It should rather be left a little damp for the use of the Carder.

I believe that I have said all that is necessary respecting Dyeing Black upon Wool, and anything that is wanted to be known further, may be gathered from an inspection of the Recipes.

COMMON BLACK.

Dyeing Process.

Logwood, 35 lbs.
Fustic, 5 lbs.
Urine, 2½ gallons.

Boil two hours.

Mordant Process.

Sulphate of Iron, 5 lbs.

CHROME BLACK.

Mordant Process.

Super-Tartrate of Potash, 1 lb.
Potash-Sulphate of Alumina, 1 lb.
Bichromate of Potash, 2 lbs.

use ½ pint O.V
2 lbs salt cake
instead

Boil one hour and a half.

Dyeing Process.

Logwood, 33 lbs.
Urine, 2½ gallons.

Boil one hour.

MADDER BLACK.

Dyeing Process.

Madder, (Mull) 20 lbs.
Logwood, 20 lbs.
Shumac, 10 lbs.

Boil two hours.

Mordant Process.

Sulphate of Iron, 7½ lbs.

Boil one hour.

This Black will stand boiling in common Vinegar for five minutes without flinching.

BLUE BLACK.

Dyeing Process.

Logwood, 30 lbs.
Camwood, 3 lbs.

Boil one hour.

Mordant Process.

Potash-Sulphate of Alumina 1 lb.
Sulphate of Copper, 1 lb.

Boil half an hour; then Sadden with 3 lbs. Sulphate of Iron, and boil one hour.

Any of the foregoing Blacks are well adapted for Mixtures.

INDIGO, OR PROOF BLACKS—BLUE BLACK.

Woad to one third full Blue:—wash well.

Dyeing Process.

Logwood, 25 lbs.
Fustic, 2½ lbs.

Boil one hour and a half.

Mordant Process.

Sulphate of Iron, 3 lbs.
Sulphate of Copper, 1 lb.

Boil one hour.

JET BLACK.

Woad to two-thirds full Blue; then wash well.

Dyeing Process.

Logwood, 30 lbs.
Shumac, 10 lbs.
Fustic, 5 lbs.

Boil two hours.

Mordant Process.

Sulphate of Iron, 4 lbs.
Sulphate of Copper, 2 lbs.

Boil one hour.

BY ANOTHER METHOD.

BLUE BLACK.

Madder, (common) 45 lbs.

Boil two hours; then Woad up to a sufficient darkness in the Vat.

JET BLACK.

Camwood, 25 lbs.
Fustic, 25 lbs.

Boil two hours; then Woad up to a sufficient darkness in the Vat.

MIXTURES.

As Cloths of medley colors, or mixtures of different kinds of colored wool, are more or less in fashion or demand, at all times, both in Broadcloths and Kersymeres, but more especially the latter, it may not be amiss, in a work of this kind, to introduce a few of these fancy things of different composition to what are usually offered in the market.

There has been too little attention paid to this method of getting up colors in the United States; the manufacturers have confined themselves to a very few varieties, both in Kerseymere and Satinet, and those have have been chiefly such as Black and White, in various proportions, would make.

There has been a reason for this; but more particularly in the Satinet business. These manufacturers have been carried away by the certain knowledge that if they made mixtures requiring a variety of handsome colors, they would be obliged to hire a Dyer that understood how to make them, and he, of course, would demand higher wages than a fellow they could call in from the woodpile, give him 20 lbs. of Logwood and about as much Copperas, and say: "Here! we want you to color Black for us." The next day they call this "hewer of wood" *a Dyer*, forsooth!

But this getting Dyeing done *so cheap*, is not exactly the thing, in the long run; for the whole batch of manufacturers follow the same plan, and as any fool can *color Black*, they are coloring it here, there, and everywhere; and the consequence is, that the market is deluged with this same eternal, poverty-looking, Black-mixed Satinet; and these *very cunning economists* return from the city with their fingers in their mouths; and if you ask them, "How's the market?" "Oh! very dull—no demand—chock full of goods—no business—banks won't discount—but we shall have a change in the administration—a new president next year—another tariff," and such like nonsense: but I tell you it is no such thing; the business is neither dull, nor yet is the market overstocked with any other kind of goods than such as *you* send, and the people are disgusted and tired of seeing them—the fault is in you, and not the market—change your track—bag your wooden Dyer—pull your hands out of your pockets and act like men—slap an advertisement into the newspaper that a first-rate Dyer is wanted; one who understands the Art of Dyeing, to whom a liberal salary and good treatment will be given, and when you have got a good manager in this important branch of business, just let him have his own way, and take care that you don't part with him; it would be much better for you to lose your skin. Give over dyeing your rotten Black and White, and turn to making Fancy Mixtures.

I merely give the above rather harsh rebuke, with the view of inducing the particular class of manufacturers alluded to, to commence a better style of work in their branch of the Woolen Manufacture; and by way of apology for my rudeness, I will favor them with some formula in a tabular form, for a few Mixtures, which I hope may have a tendency to mitigate the curse I so bitterly complain of. It is to be remembered that the proportions given in the Table are for every 100 lbs.; or so much per cent. of each color in the Mixture.

TABLE OF MIXTURES.

Blue Mix.	20 White, 80 Middle Blue.	Purple Mix.	33 Crimson, 67 Blue.
Blue Mix.	30 Puce, 70 Middle Blue.	Mule Mix.	30 Drab, 70 Blue Black.
Iron Mix.	33 Light Blue, 67 Black.	Plum Mix.	30 Full Puce, 70 Dark Slate.
Olive Mix.	9 Lemon Yellow, 91 Black.	Oxford Mix	¼ White, 99¾ Rich Black.
Olive Mix.	20 Lemon Yellow, 80 Black.	1st Black Mix.	2½ White, 97½ Black.
Claret Mix.	30 Bright Green, 70 Claret.	2d Black Mix.	10 White, 90 Black.
Violet Mix.	15 Yellow, 85 Blue Violet.	3d Black Mix.	15 Puce, 85 Black.
Violet Mix.	20 White, 80 Blue Violet.	Steel Mix.	15 to 30 White, 85 to 70 Black.
Rhododendron.	20 Full Puce, 80 Olive.	Green Mix.	70 Middle Green, 30 Fast Lilac.
Hare Back.	30 Drab, 33 Red, 37 Black.	Iris Mix.	20 Yellow, 30 Red, 50 Blue.
Silver Grey.	36 Slate Light, 36 Purple, 28 White.	Cadet Mix.	33 White, 34 Black, 33 Blue.

ON THE SCIENCE OF COLORS,

OR THE NATURE AND PROPERTIES OF COLORING-MATTER, BEING AN INQUIRY INTO THE ULTIMATE CAUSE OF COLOR.

MY design in this article is not to give a description of the rough Dye-Stuffs, such as Logwood, Fustic, Shumac, &c., nor the peculiar properties of their watery substances, the particular shades they produce, the permanency or fugitiveness, cost, or the effects they may have upon the Fabric to which they are applied; but my object is to consider what is the *cause* of Color; or to make the inquiry, what is that principle or property which is possessed by all vegetable substances in general, but by the Dye Stuffs in particular, that when united to a metallic oxyde or earthy base, produce an artificial or a natural Color.

It is not my intention to touch upon the colors that we see exhibited in the Vegetable, Animal, and Mineral Kingdoms, further than is necessary to show the similarity of composition existing between these productions of Universal Power, and those colors artificially manufactured from natural principles, with which man adorns his person and his habitation with Glory and with Beauty.

Throwing aside, then, everything foreign to what we have in view, I shall descend to First Principles, in as rapid a manner, and by as few steps as possible, dwelling upon nothing but what may be essential to illustrate the subject; and to elucidate our meaning we will begin by making a decoction of any of the Dye-Stuffs; say Logwood or Fustic, &c., (they all contain what we are after,) by boiling up Logwood until all the soluble matter be extracted from the wood, and then evaporating this solution to dryness, we obtain a deep plum-colored resinous substance, known familiarly to Dyers, as the extract of Logwood, and which is in weight about one fifth the Logwood from which it was extracted, and will produce the effect of five pounds of Logwood in Dyeing; we have now taken one step towards obtaining the coloring matter of this wood in a state of purity, but yet this extract is not the pure coloring matter or principle that gives Black with the Oxyde of Iron or the Copperas; for the Extract is the mass of pure color, Extractive matter; Tannin, Mucilage, and all the soluble juices contained in the rough Logwood evaporated down together, forming a heterogeneous mass, of which the pure color only makes a part, and it requires further operations to free it from these principles before it can be exhibited in a simple and pure state; for this purpose we now dissolve the brittle, resinous-looking Extract of Logwood in Alcohol, then filter and gently evaporate this solution until we observe a thin scum or pellicle forming on the surface; set it aside to cool, and when cool, a rough mass of crystals deeply colored is the result: finally, on dissolving these again in Alcohol, filtering and leaving them to natural evaporation, clusters of needle shaped crystals of a white roseate hue are formed; this is the pure coloring matter of Logwood; the unmasked principle that gives with alum a purple shade; with solution of Tin, a Blue, with deep purple cast, or what is termed the Mazarine Blue; and with Sulphate and Nitrate of Iron, a deep Blue Black; this small quantity of crystals producing as much color, but with more brilliant shades than the whole weight of Logwood from which the Extract they have been obtained from, was procured.

This Crystaline substance then, is what is meant through the whole body of this work, when I am speaking of the Coloring principles, and I have given this example of it from Logwood, because the Extract of Logwood is in most general use among Dyers, and its properties better known than the extracts of most other Dye-Stuffs; but I have made the same kind of experiments (with necessary variations) upon Fustic, Quercitron Bark (using one fifteenth of gelatine to precipitate the Tannin) with Weld, with Heath, and a great variety of vegetable coloring stuffs, with like results.

Fustic and Heath afford crystals of a pale, delicate amber color; Weld, a pale lemon shade, and Quercitron, a straw color; all giving copious, rich Yellow precipitates, with Alum and the solutions of Tin.

Cochineal yields beautiful rosy colored crystals, by a treatment with Alcohol and Nitric Æther; Lima Wood, Brazil and Nicaragua and all the red coloring woods afford crystals plenteously.

Indigo, which is only the inspissated extract of the Anil or Indigo plant, (Indigo fera Tinctoria,) crystalizes only by sublimation.

At a heat of between 500 and 600 degrees, Indigo evolves a beautiful crimson-colored vapor, having a very peculiar smell; this gas being caught in a cooled receiver, condenses into needle-shaped crystals of a crimson purple shade, glowing with intensity and richness of color.

The crystals are about one-tenth the weight of the Indigo employed, yet when taken alone they produce a better color than ten times their weight of the kind of Indigo from which they were extracted will do.

Such articles as I could not procure crystals from were Nut Galls, Madder, Barwood, Sanders, Lac, Butternut, Walnut, Oil nut, (neither from the bark nor the husk or rind of the fruit,) and several other articles that give a dun kind of coloring matter, and whose principle properties are Tannin; such as Catechu, &c., which I have operated upon, afforded me nothing but a pulpy, dark colored uncrystalizable substance; but in the case of Madder, Barwood, Munjeet, &c., I am inclined to think that crystals can be obtained from them, by very careful and nice management of the experiments made with that end in view; Shumac, both the common ground of Commerce and the other natural wild Shumac of the United States, as well as Camwood, give me a residuum of partly crystalized and partly pulpy matter.

From the uniform results of these experiments which I have made time and again, I feel warranted in asserting to you that the *pure* coloring matter (of all vegetables) or the principle that *creates* a color when united to a Metal or an Earth, is a particular and undefined Crystaline body, and that it is this Crystaline substance only, that is required in Dyeing to produce the most brilliant effects.

Why is it that Cochineal, Quercitron Bark (especially when deprived of its Tannin by one tenth its weight of gelatine) and Weld, produce more beautiful colors than Lac, Madder, Fustic, Shumac, &c.? simply because Cochineal, Quercitron and Weld, furnish an extract containing a great quantity of *pure* coloring matter, and devoid, in a great measure, of those substances peculiar to each of the other named articles, which, uniting to the fabric along with their color, hides and conceals its beauty.

For very dark ombre colors on woolen fabrics, such as Browns, Olives, &c., perhaps the Tannin Extractive matter, Gallic Acid, &c., and other soluble principles which accompany the *pure color* in its extraction from the Dye Stuffs, may be useful in filling or bodying-up these heavy colors, but that such extraneous matters give a greater degree of permanence to these colors, (which some contend for,) I am by no means certain about; for I have always observed that those Dye-Stuffs which furnish the coloring matter in the greatest purity and quantity, generally give the most permanent and beautiful colors: witness the effects of Weld, Cochineal and Indigo; but on Dyeing the finest and most splendid colors, such as Yellows, Scarlets, and their shades, it is absolutely necessary (if possible to obtain it) that we should have the coloring matter in the most simple form, and divested of every thing that has a tendency to produce dun or tawny shades; the importance of this observation is well known to Calico-printers and the Dyers of Turkey Red upon Cotton, who take all necessary precautions to get rid of the spurious matters that their coloring liquor contains.

The Calico-printer divests his Quercitron Bark Liquor of its Tannin, by the addition of Glue, or some other gelatinous substance, which precipitates it, leaving him a pure, coloring liquor which affords a brighter color and leaves a clearer white than it would have done without such precaution, and so on he proceeds with any particular color, using such kind of precipitant as the nature of the obnoxious substance contained in it may seem to demand.

The Turkey Red Dyer also uses in his kettle along with the Madder, a certain quantity of Bullock's Blood; the albumen of the Serum and the Fibrin of the Crassamentum of the Blood, both having a tendency to unite with, and to precipitate the dun or tawny matter which Madder always contains; by this means the color bears boiling in the process of Dyeing, and exhibits a brighter and more rosy tint when Dyed, than it would without the use of such an article, for such a purpose.

Analogous processes or substances may be employed by a skillful Dyer in some of the processes and colors employed on Woolen Fabrics.

Of what vast importance and utility to the beautiful art of Calico printing will be the discovery of a method of manufacturing in our work shops these crystaline principles that will give the Primary Colors in their purity.

The crystals of the coloring-principles of Cochineal and Logwood were discovered, the former by Pelletier and Caventou, and the latter by M. Chevreul, and called by them Carminium and Hematine, and an account of their discoveries was first published in England by Dr. Ure, of Glasgow, in his notes to Bartholletts' Elements of Dyeing, about thirty-seven years ago; in the same notes, Dr. Ure, also describes, at length, his own experiments for the elimination of the pure coloring-principle of Indigo: and to the valuable and able observations contained in these notes, I would particularly direct the attention of Dyers.

But it does not appear from any observations there made, that either Dr. Ure, or any of the other scientific gentlemen named, suspected that these crystaline bodies represented the real form and appearance of the coloring-principle of all vegetables; they probably only considered them as products peculiar to these particular drugs, and not the representing characteristics of coloring-matter in general; hence, the idea of *all* coloring-matter being a crystaline body, not occurring to them, they made no further experiments upon the other Dye-Stuffs with the view of eliciting a general principle.

Yet some years before the publication of the above discoveries, the accidental crystalization from Cochineal had been noticed; and above fifty years prior to that, the crystals of Indigo were known to some of the English Blue-Dyers; but they merely mentioned it, and considered it as a curiosity; they had then neither the inclination nor the ability to examine and find out what it was; nor did they know or think that these spangles were all the color that the Indigo contained.

Indeed, it would have been impossible for the crystalization from Indigo to have remained unknown, where large quantities of it were used; for the accidental falling of a piece of it upon a shovel of hot coals, and the consequent condensation of the gas, in passing the cold walls of the Dye-house, would discover it; other accidents of a similar nature frequently occur to bring such a circumstance into notice.

So that, if no scientific experiments had ever been made upon it, the natural operations of physical laws would have forced it upon the attention of the human mind.

Having now ascertained that Quercitron Bark, Fustic, Heath, Weld, and all the Red Dye Woods, with Cochineal, Logwood and Indigo, afford us Crystaline substances, whose effects in coloring evidence them to be pure Coloring principles of the respective drugs from which they are drawn, are we not justified in asserting, that obtaining these results from so many sources, it is a demonstration that the Coloring matters of *all* Vegetables are possessed of the same general character and properties ? and we are irresistibly led to the conclusion that the property common to all Dyeing matters, of producing colors with Metals and Earths, resides in a peculiar and much attenuated substance diffused through them, which on being separated and obtained pure, always presents itself in the form of Crystals.

Co-existent with these facts, is the idea: since these Crystals, now identified as the Coloring Principles, are not essential to the growth or the life of vegetables, nor answer any productive purpose in the economy of nature, that they have been created by the author of all things, with the design and for no other purpose, than to ornament, and give splendor and glory to the workmanship of his hands; and to afford a continual mental feast to intelligent beings of His creation, by spreading around them beauties of the highest order, which elevate the soul to Him, and diffuse pleasures such as Angels feel.

We have now shown what is the Cause of Colors, in the artificial process of Dyeing; but yet these details are of no further use than to point out what particular principle (contained in the Dyestuffs) is the active agent in producing these results.

But our aim must not be to rest satisfied with the mere discovery of the Coloring Principles, but endeavor to turn this knowledge of a natural fact into a practical benefit, and to bring this about I wish to call the attention of men of Science in general, but manufacturing chymists in particular, to a few suggestions I am about to make regarding the direct Manufactory of the Coloring Crystals, by combining together the original Elements of their composition.

In the first place, with this object in view, the crystalized coloring principle of Indigo; of Cochineal and the other Red Dyestuffs;

of Weld and the most permanent Yellow Dyestuffs; also Logwood, &c., should be carefully examined and analyzed, so that their constituent elements may be ascertained; and when this is effected, attempts should be made to manufacture (from these elements) those kinds of crystals which are known to give the three Primary Colors ot the most permanent character.

When we have obtained crystals in this manner,—which yield durable Yellows, Reds and Blues,—all will be done that the art of Dyeing requires, in this respect; as from these three coloring matters all the other shades and colors, in Dyeing, will be derived by proper methods and treatment.

That such a task is not beyond the limits of Chemical research and power to accomplish, we have proof already in the manufacture of the coloring-principle of Prussian Blue; in combination with Potash, in the Prussiate of that alkali.

There, then, is an example and a starting point, that ought to act as a spur to future and greater exertions by us, to render ourselves independent of the unknown processes—the rough materials—and the costly and precarious supplies of the distant laboratories of Nature for our Dyeing materials.

Whenever this desirable object shall be attained, it will be a source of great profit to the manufacturing chemist, and of incalculable benefit to the Art of Dyeing, by furnishing it with coloring-matter, whose qualities being always alike, the effects and quality of it can be depended upon with the utmost certainty and confidence: being pure coloring principle, also, and that of the most permanent kind, results will be obtained that the Dyer of the present day can form no idea of.

Calico-printing will be more benefited by such a discovery than the Art of Dyeing; because its colors, peculiar style of work, and the great concentration of its liquors,—all demand the coloring-matter in a state of purity, and as free as possible from any extraneous substance, that has a tendency, either to deaden the Whites, or impair the beauty of the colors.

The manufacture of artificial coloring principles would save the color-maker of the calico-printer, an immense sight of trouble and expense, now incurred in obtaining his rough extracts or decoctions from the present Dyestuffs.

With the production of artificial-coloring matters, will commence a new era in the Art of Dyeing and Calico-printing, and a complete change will come over their processes and operations, and the present methods and materials will only be remembered as things that were.

It is altogether likely that this species of coloring-matter will be produced at much less cost than the bulky and expensive articles we now employ; as, in all probability, the elements of its constitution may be found in the refuse vegetable and animal matters that we now cast out from under our feet as useless.

The advantages flowing from such a step, both directly and indirectly, in other respects, are too many to enumerate. In whatever light we view this interesting subject, it presents an aspect both pleasing and profitable.

It will exempt us from scarcity and suspension by those accidents which affect our operations at the present day; for we have now at great risk and exposure to fetch our Dyestuffs from the four quarters of the world, and the uttermost parts of the earth; — every country, every climate of the globe, and every portion of the vegetable kingdom, are ransacked to furnish the Dyer with a small quantity of a peculiar matter, that, in time to come will be manufactured at his own door; and yet, so uncertain are these various and distinct sources, that human warfare, too much rain, or the withholding it from a small territory, or so slight an accident as the foundering of a single ship, are sufficient to cut off the supplies of some of the Dyestuffs from a whole nation; and the firing of a musket, the passage of a cloud before the sun, or the puffing of a breath of wind, are now causes which arrest the manufacturing operations of a large country.

All these inconveniences and disadvantages will be removed by manufacturing coloring-principles from their original elements, as is now done by other chemical compounds, which formerly we depended entirely upon Nature to furnish us with.

These are some of the circumstances connected with this subject, which should induce the enterprizing Chemist to labor in that unexplored field, which promises such an abundant harvest of good things; and I call upon him to enter in.

If, then, in its dim and obscure outlines, it presents apparently such glorious results, what may we not expect when we have viewed it thoroughly, and examined it in all its details? We should be astonished at the effects of human skill and science; nay, I confidently predict the time will come when this thing shall be accomplished; and while contemplating it as a vision of the future, the spirit of a prophet comes upon me, and piercing the veil that separates us from futurity, down the long vista of many years, I perceive the generation that has seized upon these *first* principles, adorning themselves in raiments glowing with living colors; the transparent coloring of the Hyacinth, the Ruby and the Amethyst are theirs; their waving banners, dipped in the tincture of the heavens, radiated with celestial hues of Gold and Crimson and Azure; —gorgeously attired, in their midst, I behold the ***Man***, the illustrious Donator of this gift to them; standing between the temples of Science and Fame; they are bestowing upon him the honors of a benefactor;—they are giving him a never-dying name; — they are crowning him with a diadem of immortality.

Having now shown what the coloring-principles are, or determined what the cause of color is, and having thrown out a few suggestions on the practicability and advantages of its artificial manufacture, we will proceed to an investigation of its nature and properties, and endeavor to ascertain to what Class of substances it belongs, or to which it may be said to bear the nearest resemblance in its habitudes and effects.

I shall try to elucidate this by its effects in the operations of Dyeing, and by the manner in which it comports itself with different substances.

I have already shown that when a metallic or earthy solution is poured into a liquor containing a Coloring-principle, that the transparency is immediately disturbed and a flocky substance separates from, and falls to the bottom of the liquor, forming a precipitate or Lake; and I have said that the formation of this Lake, exhibited the real manner in which the component parts of color unite, and what are the constituents of its composition.

In this experiment we see a power exerted by the Coloring-principles which is greater than the force of the acid or acids that held the metallic or earthy base in solution; insomuch as the Coloring-principle separated the metal or earthy base from its connection with the Acid, and formed a new compound with it, differing from the former entirely, in its appearance and properties; it is also a more close, intimate, and forcible combination, because this new compound possesses greater solidity and a stronger tendency to insolubility.

In this instance the Coloring-principle appears to comport itself with mordants in a similar manner to what the astringent or Tannin principle would do, and in this respect seems to approximate nearer to an astringent than to an acid in its nature; its action upon wool is also like the action of an astringent upon the same substance which apparently identifies its properties in this particular with Tannin.*

In some cases the affinity between the Coloring-principle and the base of the color is so firm and compact that they form a precipitate or Lake, which is absolutely insoluble in water. A color of this nature can never be applied to goods at one operation in the process of Dyeing; but the Mordant must first be combined with the fabric to be Dyed, and the Coloring-matter in a fresh bath afterwards.

So powerful is the action of this coloring-principle upon earths and metals, that it will (in some extreme cases) dissolve, or combine with some of their most insoluble Salts, whether they have been precipitated by an astringent or acid.

Thus, the precipitate of the Tannate and Gallate of Iron, dissolves in a solution of the Coloring-matter of Logwood or Fustic; and a certain quantity of the colorless and insoluble Sulphate or Muriate of Lead dissolves in the Coloring-matter of Logwood, causing the liquor to assume a deep, dull, blueish Black, which it will communicate to cloth boiled in it.

Again; any lake or color of but slight solubility in water, will generally pretty easily dissolve in a solution of the coloring-principle of which that lake or color was made. This is exemplified by many colors in the process of Dyeing, when, after having been brought up to a particular shade in a certain time, by continuing the operation longer, the color is observed to grow poorer; or as Dyers say, to *boil off*. This effect is caused by the coloring-matter being in excess, or more than was necessary to precipitate the Mordant; when a re-action taking place, by virtue of the property above-stated, the coloring-matter has begun to re-dissolve the precipitate that was formed and had fixed itself upon the fabric; in this case, the remedy will be to give more Mordant.

---

*See Article on the different Processes of Dyeing for an explanation.

In Dyeing Scarlet and other colors on woolen goods, this effect is very observable; also in Black, but more especially, in Dyeing Black on cotton; when, after the color has been brought up rich and full, (if the color in the Dyeing bath be much more in quantity than the Mordant on the cloth required for its saturation,) it begins to grow worse the longer it remains in the liquor; until finally, it is brought down to a mere Slate color; a strong proof that when the coloring-principle is in excess, it possesses the property of dissolving its own insoluble precipitates.

These circumstances show the care that is necessary to be taken by a skillful Dyer in proportioning the relative quantities of the Mordant and Dyestuffs, so that they may mutually saturate each other, without having either of them in the bath, either as a useless or noxious superfluity; but if either of them be allowed to exceed the other beyond the point of neutralization, it ought to be the Mordant.

This exposition also points out the necessity of seizing the precise time, when the color has arrived at the desired pitch of shade, to withdraw the colored article from the kettle, or to stay the further operations of the Dyestuffs, lest the color suffer by a too long exposure to their action.

The property of dissolving its precipitates, would incline one to suppose that in this particular the coloring-principle approached in its nature to the constitution of an acid; as some of these substances, when added in excess to their insoluble salts, are capable of dissolving them; for instance, the insoluble Sub-Carbonate of Iron is dissolved in water containing Carbonic acid; and so on of several other salts.

The effects of the Alkalies and this principle upon each other, go to show that they are posseessed of antagonistic properties; and if this does not prove the coloring principle to be a positive acid, it will at least convince us that it has acid powers, though in a feeble and incipient state.

The solution of Indigo in Vats containing either Lime, Ammonia, Soda, or Potash, deprives these alkalies of their caustity; and the solution of any other coloring-matters produces the same results, neutralizing, in a great measure, (when the proportions of coloring matter and alkali bear a proper relation to each other,) any of the alkalies or alkaline earths, and causing them to resemble, in their action, the neutral salts. Under other circumstances, alkalies and coloring-matter mutually aid each other in acquiring solubility.

But there is a very marked difference between the affinities of acids and the coloring-principle for different substances; for any of the acids have a stronger affinity for alkalies than has the coloring principle; and the coloring principle has a stronger affinity for metallic oxydes and the soluble earthy salts than acids have, precipitating them when held in solution by any of the acids.

The coloring-principle, also precipitates the metals and the earths, when held in solution by any alkali; thus demonstrating, that between this principle and the metals and earths, there exists a more powerful affinity or attraction than between them and any other substance; and that these two, obeying the law of Elective Affinity, reciprocally select each other from among masses of matter, in preference to combining with any other substance. Hence arises, by the force of this natural law, all the variety of colors distributed through the vegetable, the mineral and the animal world.

On a review of the foregoing observations, I come to the conclusion that this vegetable crystaline coloring-principle, is a substance that possesses properties common to both astringents and acids, in some cases, and in others, exhibiting an action different from and more powerful than either of them;—that it has some properties peculiar to itself, which distinguish it from all other substances, and giving it a rank as a distinct principle, and isolating it as an individual production of Nature;—that it seems to occupy a medium station between astringents and acids, partaking of the nature of both, but its prevailing tendencies inclining to acid formations;—that it stands in the same relation to vegetable, that Sulphur does to mineral substances;—the latter being neither a metal nor an earth, and the former neither astringent nor acid;—that its compounds seem to bear some resemblance to Sulpherets in their nature, for the greater part of its colored precipitates absorb Oxygen from such substances as part with it to the Sulphurets, and it is only when the metallic part of its compound is oxydized to a maximum, that it suffers no change in this respect. Hence, when dyed, those colors are the least subject to change by exposure to the air, the metal of whose precipitate has been Oxydized to saturation;—that from this similarity in the aptitude of the coloring-principle to a Sulphuret, which contains the base of an acid, I infer that the crystal coloring matter of vegetables only requires oxygenation to convert it into decided acids, differing very little in their properties or effects from the acids that give the different mineral colors. In finale, that the coloring-matter of vegetables, is an unknown acidifiable base.

All the colors of the mineral kindom are produced by a coloring-principle, which, in all cases, is either an acid, or a substance that is capable of becoming acid, by the addition of Oxygen; and this fact, compared with other effects and modes of action common to both the vegetable and mineral coloring-principles, declares, (as far as analogy can declare) that these two principles, are, in substance, the same, only existing under different modifications. And I am led to believe that the mineral coloring acids which we find united with metals, forming masses of fossil color, have once existed as juices in vegetables, and were the coloring-principles distributed through the herbaceous races that flourished before the present order of things began—the splendid remains of the coloring-principles of a former world.

That there are as strong proofs in favor of the above hypothesis as there is that the coal formations were once vegetable matter, I will show by a comparison between the vegetable coloring-principle and the mineral coloring acids; and this comparison will also serve to exhibit the difference between vegetable and mineral colors, in many interesting points.

COMPARISON BETWEEN THE VEGETABLE COLORING-PRINCIPLE AND THE MINERAL COLORING ACIDS.

Mineral Coloring Acids.		*Vegetable Coloring-principle.*
Crystalizable Substances, in general.	Mode of Existence.	Crystalizable Substances in general.
Decided Acids; or Substances capable of becoming Acids.	Nature.	An Inert base, capable of acidification.
Crystalizable Salts of different degrees of Acidity.	Comportation with Alkalies.	Neutralizes Alkalies—not ascertained whether crystalizable or not.
Precipitates the Acid Salts of, and forms triple Salts with their Alkaline Solutions.	Metals and Earths.	Precipitates both the Acid and Alkaline solutions of them.
Insoluble Powder; all colors; brighter than Vegetable Precipitate; colors easily affected by Alkalies; resists Acids.	Character of Precipitates.	Some insoluble; the rest sparingly soluble; of all colors; changeable by alkalies deepening the colors; Acids greatly affect some, and others not at all, or but slightly.
Stronger affinity for Alkalies than for Metals and Earths;—possesses greater power than Vegetable-coloring principle, because it displaces from the Earths and Metallic Oxydes.	Comparative Properties and Affinities.	Stronger affinity for Metals and Earths than for Alkalies; gives up the Metals, Earths and Alkalies to the Mineral-coloring Acids; it is, therefore, a weaker Coloring-principle.

I could continue the comparison between these two Species of Coloring substances, in other respects, much further, but this must suffice for the present.

A BRIEF REPETITION OF THE NATURE AND PROPERTIES OF THE COLORING-PRINCIPLE.

THE pure Coloring-matter of Vegetable Dyestuffs is a crystaline body or Salt; seeming to partake of the nature both of an Astringent and an Acid; yet in some cases differing from, and being more powerful than either of them; distinguishing itself from them as a separate and particular substance, which forms compounds with the metals and earths of a similar nature to the Sulphurets, Hydro-Sulphurets, and mineral Coloring-acids with the same bases. Hence, the conclusion, that it is an *unknown* acidifiable substance; its comportment with the Alkalies, also, seems to confirm this opinion. And as all mineral colors are due to an Acid, or an acidifiable principle, and artificial colors differing very little from these, it appears reasonable that the vegetable and mineral coloring-principles are substantially the same, and that we are justified in ranking the vegetable coloring-salt in the same class of substances as Sulphurets, Hydro-Sulphurets, and certain coloring-acids.

It possesses great solvent powers, as in some examples it dissolves the insoluble metallic Salts, such as Sulphate of Lead, &c. it will also cause the oxydation of a simple metal, and then dissolve its oxyde: for instance, iron turnings or filings, become oxydized and dissolved in Logwood, and several other Dyeing liquors; other metals, also, undergo the like dissolution.

These facts indicate its acid properties, although the metals, not dissolving in it either so readily or in such quantity as in acids, are no proofs that this principle is not an inert or latent acid, which only requires the existence of certain affinities to call its powers into active operation.

It also dissolves some of its own Precipitates or Lakes, which are insoluble in mere water. It destroys the causticity of Alkalies, and remains in solution with them; but the addition of metallic oxydes or Alumina, precipitates the coloring-matter from this solution, carrying a portion of the Alkali down with it.

It separates metals and earths from their Acid and Alkaline solutions, showing that those minerals have a greater disposition to form Lakes or Colors. than they have to enter into combinations as soluble Acid Salts; consequently, Coloring-matter and the metallic oxydes, stand in the same relation to each other, that Acids and Alkalies do to themselves; that is, they possess opposite natures or properties.

Perhaps if color was operated upon by a Galvanic battery, the positive and negative poles would settle this point.

Vegetable Coloring-principle is weaker than the mineral-coloring Acids, and does not form such solid and unalterable combinations; neither does it resist Acid tests as well, but it withstands the action of Alkalies better.

The Coloring-matter or principle of the vegetable Dyestuffs, possesses one general and definite character; but there are modifications of it which divide it into three principal branches; producing, by a cause unknown, three different species of colors or effects, viz: the Yellow, Red, and Blue.

I have shown elsewhere that those vegetable Dyestuffs which produce Yellow, are natives of all the climates; at least from the Tropics to as far towards either pole as the belt of herbaceous vegetation extends—that Yellow is afforded by a greater number of plants than such as give Red or Blue Coloring-matter; and that it is of less permanent character than either of these colors—that such plants as furnish the Red species of Coloring-matter are productions of the temperate regions, chiefly—countries extending into high northern latitudes not producing any of them; and that the first circle of their specimens commences within the torrid zone—that plants furnishing this species of Coloring-matter, are not so abundant or widely distributed; but they afford a Coloring-principle that gives a faster color than such as produce Yellow—that Blue is entirely the gift of the equatorial regions, and is never successfully cultivated much beyond their limits; and that there is only *one* plant that supplies us with a positive and permanent Blue —the Anil, or Indigo plant.

From the circumstance of certain localities producing the different species of color or Coloring-principle, may I not draw the inference, that the different degrees of condensation or absorption of the solar influence by the Coloring-principle placed in vegetables, determines its Yellow, Red, or Blue effects?

In other words, it shows that Yellow requires least exposure to the sun's action to produce it, and Blue the most; and that the effect which we call Color, is the result of the abstraction of the celestial hues from the solar beam by the affinity of the Coloring-principle for it, and on this latter impregnated principle coming in contact with metallic oxydes, these hues are immediately developed, and exhibited to the human eye, as from a prism; and that all colors, whether artificial or natural—whether of flowers, of birds, or beasts, of minerals, or such as man artificially compounds for his own gratification—every Color, on whatever seen, has originally been a sun-beam in the heavens; and the impregnation of the Coloring-principle with a ray of this imponderable entity, and being by it transferred to an oxyde, which then reflects it upon the eye, constitutes the whole Philosophy of Colors.

Therefore, the Dyer, while engaged in the operations of his glorious profession, is performing no less an act than transfusing celestial tints through terrestrial fabrics—he is imbuing material substance with the immateriality of Light—he is endowing inert and lifeless matter with the vitality of coloring, and infusing spirit and energy into that which is dead and powerless!—he is a co-worker with the Eternal; almost breathing the breath of life into the workmanship of his fellow-men, saying: Go to: run and be glorified.

Beyond all; behind this screen of light and splendor, exists the unapproachable Cause of Color—the immediate Power of God—the Deity.

Having traced these effects through their various channels back to that Source from whence they, and all other effects proceed, and to which they finally return again; up to that first and incomprehensible Cause of all things—that Vitality of all Existence—that Energy of all power—the only Reality—the Self-Existent, Unknown, and wonder-working Deity—let us pause and contemplate, ere we resume the further study of this department of His handiwork.

ON THE CONSTITUTION, AFFINITIES, OR PROPERTIES OF COLOR.

I HAVE shown that the cause of the Dye-Stuffs giving a Color with metallic or earthy salts, is owing to a peculiar principle which they contain, that is, a crystalized body, when pure, having a greater affinity for metals and earths than it has for any other substance, precipitating them when held in solution by either Acids or Alkalies, and producing compounds or Lakes of but slight solubility, which have a natural tendency to enter into combination with animal fibre, effecting a triple union of Coloring-principle, metallic oxyde and animal matter, the force of whose combined attractions, water or other common agents are not capable of separating.

To this precipitate or Lake, we give the appellation of Color; and the knowledge of making it, with the subsequent process of combining it with wool or manufactured fabrics, we designate as the Art of Dyeing or Coloring.

A Color, then, in the abstract, consists of two parts, principles, or substances only; and the forming of this compound of the best quality, and fixing it in the most permanent manner upon a fabric, with a knowledge of those Chemical Laws upon which these effects are founded, constitutes the skill of the Dyer.

Therefore, a Color is a Chymical Compound or Colored Salt; and Coloring or Dyeing, is a Chymical art.

It is this Compound whose constitution I am now going to consider.

On mixing together two clear solutions, one of Coloring-matter and the other of a metallic or earthy salt; the substances that are held in solution pass immediately from the liquid to the solid state; in some cases this change is sudden and instantaneous, and the solid result falls rapidly to the bottom of the vessel as an insoluble powder, whose particles are finely comminuted; in other instances, the mixed liquors gradually assume opaqueness; by-and-by a separation is perceived, and a broken and curd-like matter slowly subsides to the bottom, and lies in a loose, flocky state, which the least agitation causes to rise into the supernatent liquor;

it is slightly soluble: this passage from liquidity to solidity is the first effect perceived on the formation of color.

The first of these transitions being perfectly insoluble, the aggregate possesses not the slightest tendency to unite with animal or vegetable fibre; consequently an insoluble color can never be chymically combined with any animal or vegetable matter at a single operation in Dyeing, or applied as a topical color in Calico-printing; and if it should be attempted, the result would be a mere mechanical adhesion of the particles of color to the article to be colored, which the slightest friction or simple washing in water would easily remove; this shows that Dyeing is not a mechanical fixation of colors, but a Chymical combination of it with the substance that is colored.

But as the component parts of this insoluble color, have each, when separate, a strong inclination to combine with animal and vegetable tissues, and also with each other, the triple union, (or the process of Dyeing) is effected, by first impregnating the fabric with the oxyde, and then passing it through a solution of the Coloring-matter.

The perfectly insoluble colors are chiefly mineral, and their specific gravities are much greater than such as are partially soluble, or whose color proceeds from vegetable Dyestuffs.

The character of insolubility gives to a color the power of resisting decomposition by light, and the action of the atmosphere; the mineral colors (acid) possessing this quality in a more eminent degree than such as are derived from vegetables.

The most insoluble colors are therefore the most durable, and those which are extremely soluble are the most fugitive, and I believe there is no instance where a very soluble or liquid color is a permanent one.

As a proof of the correctness of this position, the Sulphate of Indigo, which is soluble to an unlimited degree, is remarkably fugitive; while the insoluble Indigo from which it was made, is the most durable color afforded by the vegetable world;—other examples of this kind are numerous.

I will now return from this digression, to the second or partially soluble kind of Color, of which nature are almost all those colors employed by Woolen Dyers; the vegetable Dyestuffs not forming absolutely insoluble compounds with the metals and earths, excepting in the case of Indigo, and perhaps one or two more instances.

This kind of color is that which forms the Topical colors, or colors of application of the Calico and Woolen Printer; or such as (all the materials of the color being mixed together,) are then applied at once by the Block, and afterwards fixed by steaming, are denominated steam colors.

Liquid colors are also applied in this manner.

The slight degree of solubility in a color of this sort is the cause of its direct union with animal or vegetable fibres; because the whole force of the respective affinities of the substances that compose the color, not having been required to produce insolubility, there still remains in each of the constituents, a power of combining with a third substance, or the article to be colored.

Whereas, in an insoluble color, the whole force of the two affinities having been expended upon each other in order to produce insolubility, there exists no attraction in this compound, for the fabric to which it should be applied; hence the impossibility of combining such a color with animal or vegetable tissues.

Therefore, such colors as are the most insoluble are those whose constituents are drawn together by an attraction so powerful, as to neutralize the affinities which have produced it; and where the metal in the compound exists in a highly oxydized state, and the coloring principle, in conjunction with it, exhibits the the character of an acid.

And as these properties of the insoluble color, have all to be transferred to the partly soluble one, before it can possess the utmost degree of permanence of which it is susceptible, the addition of a third substance, capable of communicating these qualities to it, becomes absolutely necessary in the composition of colors for wool or woolen goods.

It will be seen that the substance to be employed for this purpose must have the power of combining with both the color and the matter that is to be colored; as well as a strong inclination to form a solid combination with them.

These affinities, and this tendency, is possessed by the Super-Tartrate of Potash in an eminent degree, besides the additional advantges of minutely dividing the particles of color and softening the action of the mordant upon the animal fibre.

Practice and experience had long ago taught woolen Dyers the advantages of employing this salt as a useful auxiliary in the composition of coloring liquors, without any knowledge of the theory by which these advantages could be accounted for.

This accounts for the great use made of Super-Tartrate of Potash (or Cream of Tartar) in such colors as are applied at one operation in woolen dyeing.

Super-Oxalate of Potash, produces nearly the same effects.

Super-Sulphate of Potash, similar but more feeble results.

Tartaric, Citric and Oxalic, and all other crystalizable acids, modify the shade and render the color more insoluble, but having great acid powers they quickly re-dissolve their original precipitates, so they are not so well adapted for this purpose as their super salts; which having less solubility than the uncombined acids, increase the permanence of the color in proportion to their degree of insolubility and disposition to preserve a solid combination.

Hence the Salts, with excess of acid, are better qualified to form ingredients in the mordant of a Color than their respective acids, when in a free and more soluble state. And out of the whole number, the Super-Tartrate of Potash (or Cream of Tartar,) now used by Woolen Dyers, is the best adapted to answer the desired end.

This Salt is used, in small quantity, by Silk Dyers, for the same purpose, but in Cotton-dyeing and Calico-printing, no advantageous use can be made of it for this purpose; for as it unites with color, but has no affinity to combine with vegetable fibre, it prevents the fixation of the Color upon the fabric.

And this resistance by the Acid to the application of Color to vegetable fibre, is the reason why the proper Scarlet Color of the Woolen Dyer cannot be fixed upon Cotton or Linen goods in Cotton-dyeing or Calico-printing; because the excessive acid constitution of this Color prevents the complete saturation of the fabric with it.

On similar ground rests the employment of the crystalized Acids, which resist or discharge, in Calico-printing; from which it would appear, that if we could obtain a substance possessing strong acid powers, and that had a greater affinity for metallic oxydes, or the bases of Color, than the Coloring-principle has, (with little or no disposition to unite with vegetable fibre,) we should then be in possession of a universal resistant, which would prevent the application of any, or every Color to spaces which the Calico-printer wishes to preserve white.

The brilliancy of Color depends upon the purity of its component substances, and its intensity upon the multiplicity of particles in a given volume of it; or when the mass of precipitate is minutely subdivided into a vast number of smaller portions of Color; or, in other words, upon the quantity of points from which the colored ray is projected upon the eye.

This divisibility of Color, or the attenuation of its substance, is as infinite as ponderable matter is susceptible of, and is only limited by the materiality of its composition.

In the act of Dyeing, Super-Tartrate of Potash promotes this subdivision of the particles of Color, and the violence of ebullition greatly accelerates their comminution; as also the high temperature of steam, in the process of fixing colors by that agent.

On this process of multiplication taking place, the relative bulk and weight of the Color undergo a change; its volume becomes less and its specific gravity is increased. Therefore, those Colors whose specific gravities are the greatest, are those whose particles are the most infinite, and in consequence of this, possess the greatest intensity or vivacity; they are also the most insoluble, and of course the most permanent; they are those into whose composition an acid enters, either as the Coloring-principle, or as a modifier of the Color. They are the mineral Colors, or other Colors that have been made to approach to the nature of mineral Colors, by the addition of Acid Salt, which has greatly multiplied their particles, and produced the solid form, or insoluble state in them.

The affinities of Color (or its component parts) for such fabrics as it is customary to Dye, are greatest for animal substances; next, for vegeto-animal; and least, for vegetable matters;—or, in order, Wool, Silk and Cotton; or substances analogous to them, as hair, spider's and caterpillar's web, linen, &c.

In consequence of these specific degrees of attraction existing between Color and the several objects to be colored, there is found to be a difference in the ease with which they can be imbued with color, in proportion to the power of their respective affinities; and on this inequality in the attractive forces, originates the necessity of employing different methods and processes for combining the same color with Wool, Silk, or Cotton, in the operations of Dyeing.

From these observations, I arrive at the following deductions:

1. That when a Coloring-principle and a metallic or earthy Salt are mixed together in solution, a precipitate, more or less insoluble, is the result. This is color.

2. This color, or precipitate, is composed of the Coloring-principle and the metallic oxyde or earthy Salt employed, with (in some cases) a slight portion of the acid which served as the solvent of the metal or earth. A great excess of acid, or of Coloring-principle, will re-dissolve a part, and sometimes all, of the precipitate first formed.

3. The mixed liquor, after this precipitation of the color, contains the acid of the Salt employed, and (in some cases) retains a small quantity of the Coloring-principle with it; but when the Coloring-principle is in union with an alkali, (as in Prussiate of Potash, for instance,) in this case, the supernatent liquor contains an alkaline Salt, composed of the acid of the metallic or earthy Salt and the Alkali that was in conjunction with the Coloring-principle. Here double decomposition has been effected, and the liquor is colorless.

4. Color may be considered, in relation to Dyeing, as of three kinds: the Insoluble, the Partly-Soluble, and the Very-Soluble, or Liquid.

5. The Insoluble will only unite to a fabric by virtue of the affinities which its component parts have, when separate, for the fabric and for each other. It is the most permanent kind of Color.

6. The Partly-Soluble more readily enters into combination with the subjects of Dyeing, in the aggregate state; its sparing solubility aiding it to fix itself on the substance to be Dyed. It is less permanent than the insoluble kind.

7. The Liquid Color may be considered as only a modification of the other kinds, rendered more soluble by the agency of an alkaline or acid menstruum, which, in acting as a medium of solubility, exercises so great an action upon it as frequently to change its nature and destroy its durability. It very easily fixes itself upon a fabric, and is very fugitive.

8. Color has a natural tendency to combine with animal and vegetable fibre; either in its aggregate state, or by its component parts separately, being capable of uniting with them; and the effect produced by these affinities is termed Dyeing.

9. The Affinities of Color, or its separate constituents, for animal, vegetable, or vegeto-animal objects to be colored, are the greatest for Wool; next, Silk and Furs; then, Cotton and Linen. Woollen and Linen are stationed at the extremes of the scale; and Silk, which is partly vegetable and partly animal-matter, occupies a medium situation between the two. Therefore, by combining the methods, &c., for coloring Wool and Linen, and taking the *mean* result as the determinate manner of Dyeing vegeto-animal matters in general, it ought to give us those processes, &c., which will answer best for Silk. Experiment confirms this observation.

10. The brilliancy, brightness, or beauty of Color, depends upon the purity of its component substances.

11. The intensity, or vivacity of Color, consists in the fineness and number of the particles or points projecting the Color; or upon the quantities of surfaces reflecting the light.

12. The permanence of Color, is in proportion to its approximation to the solid state; or its disposition to form an insoluble compound.

The insoluble Colors are perfectly fast; the partly-soluble ones, moderately so; the Colors which dissolve to an unlimited extent are very fugitive. But the quality of permanence can be increased in a Color possessing little solubility, by the addition of a definite quantity of Super-Tartrate of Potash.

I here suspend the further discussion of any other circumstances or facts relating to the cause or constitution of Color, though numberless aspects in which it presents itself for consideration, could be brought forward; and although every scientific Dyer and Calico-printer must perceive (by a careful examination of this article) that not a tythe has been said of what the subject admits of; yet I know of no phenomena presented by color (or substances used as pigments and dyes) that cannot be accounted for upon the principles here laid down.

But before we dismiss this subject altogether, it will be proper to notice a few materials, which from the peculiarities of their constitution, and apparent disagreement with this general description, seem to require a separate consideration.

One of these is Indigo, which is a vegetable Color, and not a Coloring-principle; another is Cochineal, which is an insect, with whose substance is incorporated a coloring-principle, which it has been common to consider as an animal, and not a vegetable coloring-principle.

Indigo is an insoluble Color; (in its natural state and under common circumstances,) it is the most permanent of vegetable colors, being absolutely unalterable in the atmosphere, or by common agents. The pure Color crystalizes by sublimation, and forms about one-tenth part of the substance of the Indigo of commerce. It is not combinable in the humid way, in its natural state, with anything excepting concentrated Sulphuric Acid, which acts with such energy upon it, as to convert it into some other substance; for it no longer remains Indigo, as is proved by its refusing to exhibit the same phenomena in any kind of Blue Vat, or by any method employed for its deoxydation and subsequent solution in alkaline menstrua; and this, after it has been entirely freed from the Sulphuric Acid, by treating it with the fixed Alkalies of Lime.

That Sulphuric Acid completely changes the nature of Indigo is also shown by Dyeing with the Sulphate of Indigo, which gives one of the most fugitive of dyes, when applied to Woolen goods, although the Indigo from which it was made, is the most unchangeable of colors

The peculiar constitution of Indigo occasions the necessity of a different mode of applying this substance to fabrics, than is usually had recourse to, for combining other colors with articles that are to be colored.

For, as it is an insoluble Color, which Nature has made ready to our hands, whose Coloring-principle and base (if such there be) we are totallv unacquainted with; consequently cannot apply them, separately, as is done by the components of other insoluble Colors: we are, therefore, under the necessity of operating upon it as a *whole*, and combining it directly, at a single operation, with the subject to be Dyed.

As it is absolutely insoluble in water; and as it must be dissolved in that fluid before it can be applied in Dyeing, we have to ascertain in what state and by what means we can effect that object.

Chymical examination discovers that Indigo is susceptible of different degrees of oxydation, but its prevailing disposition is to acquire or retain that particular quantity of Oxygen which maintains it a Blue Color; and that like metals, it combines in definite proportions with Oxygen, and takes it from, or parts with it to different substances, and under different circumstances, according as the law of Elective Affinity determines; but its prevailing disposition is to acquire, or retain, that particular quantity of Oxygen which maintains it a Blue Color.

I have said that in its most constant state of oxydation, viz., in its natural state, it is insoluble by any means, excepting concentrated Sulphuric Acid; but the action of this Acid disqualifying it for use as a permanent dye, we are obliged to look for some other mode of existence in which it will combine with another kind of solvent that shall have it in possession of those qualities upon which its chief excellence depends.

This desideratum is found in a lower state of oxydation than the natural one, and in the employment of an Alkaline, instead of an Acid medium of solubility.

When Indigo and any metallic salt or sulphuret (possessing a greater affinity for oxygen than Indigo does) are mixed together in water, a change in the state of the respective substances takes place; the Indigo passes from a Blue to a dull Green or Olive color; this effect has been produced by the abstraction of that portion of oxygen which constituted the Indigo, a Blue color: and the metallic salt or sulphuret has become oxydized to a maximum.

If an alkali, or quick lime, be now added to the mixture, fresh appearances are observed; the Indigo rises and dissolves in the alkaline solution, and the whole exhibits the characters that distinguish a Blue Vat.

The substances employed in this case, are such as are used in Vats for Dyeing vegetable substances: and the operation is generally performed cold.

But animal substances requiring heat to effect their complete union with color, Vats of another description and of different materials are necessary in the Dyeing of wool or silk; vegetable, instead of mineral substances are employed as the deoxydizing matters; and the active force of the fermentation of these, effects the deoxydation of the Indigo more completely than the quiescent affinity of the metallic salts or sulphurets are capable of doing.

The vegetable substances most commonly used as a ferment in hot Vats, are Madder and Bran (for the Ash-vat,) and Woad, (or vegetables similarly treated,) with a small quantity of Madder and Bran, (for the Woad-vat;) but whatever vegetable substance may have been employed, the principle of their action is much the same in all cases; only differing in power according to the quantity of fermenting force possessed by the particular materials employed.

When fermentable vegetable matter and Indigo are put into water, heated to about 170 degrees, in a little while fermentation commences, and generally in the course of twelve or fourteen hours the color of the liquor has changed from a Blue to a dull Green or Olive.

In the technical phraseology of the Dye-house, the Vat has *sprung*.

This appearance indicates the loss of that portion of oxygen which maintained the Indigo a Blue-color, and this effect has been produced by the Carbon of the vegetable mass, (in a state of fermentation,) rapidly absorbing oxygen from the surrounding matters, which converts the Carbon into Carbonic acid Gas, which is thrown off from the Vat (at this stage of its progress) in great abundance.

At this juncture, if the Hydrate of Lime, or if an Alkali be added to the liquor, a sensible and marked change takes place; the color of the liquor becomes a Yellower Olive or Green, and Ammonia is appreciable by the smell.

The fermentation is again suffered to proceed, and after a proper interval of time, (during which more of the Indigo has been deoxydized,) a fresh portion of Lime or Potash is given to it, when the liquor becomes still Yellower or a livelier Green; and this addition of alkali at intervals, is persevered in, until the whole of the Indigo has been deoxydised and successively taken into solution through the medium of the alkaline solvent.

Thus, whatever means we may employ for dissolving Indigo, with the view of applying it as a permanent Dye, they must all be based upon the abstraction of a portion of its oxygen, and its solubility while in that state, in an alkaline Lixivium.

Whenever any fabric is immersed in an alkaline solution of deoxydized Indigo, or in plainer terms, is exposed to the action of a Blue Vat, the article emerges from it of the same color as the solution; but as the prevailing tendency of Indigo is to acquire that particular quantity of oxygen which constitutes it a Blue, it immediately seizes that gas from contacting objects, or absorbs it greedily from the atmosphere; on which re-absorption of oxygen it returns to its natural state, unaltered in any of its properties as an insoluble and unchangeable color.

I have but a few observations to make on the constitution of Indigo as a color; and those must be considered as merely conjectural; but I cannot avoid being of the opinion, that it follows in the nature of its construction, the same general law of colors, which determines their constituents to be a metallic or earthy base in union with another substance, which I have termed the coloring-principle; and I shall continue to believe it to be composed of a solid mineral radical, and some other color-giving substance, until it is clearly proved that it constitutes the exception to this general rule.

The same means (the Galvanic battery) that has determined the metallic nature of the earths and alkalies, would be most likely to settle this point.

I will now state my reasons for supposing the constitution of Indigo to be similar to that of other colors.

That it has a solid and mineral base, I infer from its dissolving in alkali, (when deprived of a portion of Oxygen,) without the disengagement of any gas whatever—by its re-absorption of Oxygen, like as any metal or earth will do, whose natural state is that of an oxyde, under common circumstances; and by its comportment with Sulphuric Acid, with which it forms a perfect Sulphate, possessing unlimited solubility in pure water, and the properties of this compound differing from those of either of its component parts.

That it contains something else besides this solid base, I infer from the disengagement of Ammonia during the destructive distillation of Indigo, and also from the same elastic alkali being evolved by its spontaneous fermentation when mixed into a pasty mass with water. This evolution of Ammonia, I view as the liberation of one of the constituents of its Coloring-principle.

These, then, are my conjectures for considering the pure Indigo Color as being composed of an unknown oxyde, united with a color-giving substance, of which Ammonia or its elements make a part.

Or, (supposing my conjectures to be erroneous,) shall we consider Indigo, in a deoxydized state, as a similar substance to Chromic Oxyde? and is Oxygen, in this instance, the Color-giving principle?

Or, again; if we consider the analysis of Indigo, by Dr. Ure, (1 atom of Azote, 2 Oxygen, 4 Hydrogen, 16 Carbon,) as revealing its true and ultimate constitution, then it follows that Carbon, in some states, and under some circumstances, is soluble in alkaline solutions; and that, by a union of its component elements, Indigo can be directly manufactured by man.

Cochineal.—I have but a few observations to make respecting this Dyestuff; yet the little I may say, I conclude, applies with nearly equal force, to Kermes and Lac.

The proper Scarlet Color can be produced by no other known means than a mixture of one or other of these animal substances, and a solution of Tin; and by none of these of so brilliant a tint as with Cochineal. On this account, it becomes necessary to examine a little, into the nature of that Coloring-principle which produces such splendid effects.

I said, in the former part of this article, that the Coloring-principle of Cochineal was (when pure) a crystaline body, like the Coloring-principle of other Dyestuffs; from this it will appear, that it is not the insect (Coccas Nucefera) or the animal matter of which it is composed, that gives, with solution of Tin, the regal color of Scarlet; but that this gorgeous splendor is due entirely to a small crystaline body, which is only contained among the insect mass, and is a substance foreign to the nature of animal matter.

The crystalized (or pure) coloring-matter of Cochineal, affords no Ammonia or animal products by its destructive distillation; its principles are strictly vegetable; therefore the Scarlet Color is, in its ultimate constitution, a compound of a vegetable, and not an animal coloring-principle, with the Oxyde of Tin.

And may not this fact lead us to the supposition that the red juices of the Nopal plant contain this brilliant coloring-matter, in a very attenuated state, and that the Cochineal insect has only been a Living Apparatus which the Invisible and Mysterious Chymist has made use of, for extracting and condensing it?

But, it may be said, how comes it that one of the intimate materials of vegetables should be found incorporated in the substance of an animal? I cannot tell: neither can you or I tell how it happens that farinaceous matter should be deposited within the husk of a grain of wheat; or why it produces the effect of sustaining the life of man; the process whereby these things are so, is as mysterious to me as is my own existence; a Dyer cannot tell, neither can a philosopher; the why and the how are known only to Him, "whose ways are past finding out," and of whose wisdom and power the deposition of this coloring-principle, in the body of a small insect, is an inscrutable and incomprehensible effect.

If I be right in my conjectures respecting the vegetable origin of the coloring-matter of Cochineal, then can we produce the splendid color of Scarlet at an infinitely cheaper rate than we do at present, and without being at the trouble and expense of rearing, tending and collecting the Cochineal Insect, or employing it at all in the process of Dyeing.

There has not, to my knowledge, ever been any experiments made upon the Opuntia or Nopal plant, or upon the red juices it contains, with a view of ascertaining whether or not, a scarlet could be obtained from them directly, instead of employing for that purpose, the expensive Insect which has been nourished and brought to perfection on that plant, with whose pure coloring-principle the whole body of the animal seems to be imbued.

I would therefore suggest, as a step highly creditable to the government of any country, or one which would be lucrative to any private company or individual, to send some well experienced and scientific Dyer, out to the West Indies, to Florida, Mexico, or the countries bordering on the Mexican Gulf, to make the necessary experiments upon the fresh plant or its juices, with a view of employing either the whole plant, its solid Extract, or its Crystalized coloring-principle, in the process of Scarlet Dyeing as a cheap substitute for Cochineal.

Other valuable discoveries connected with the arts of Dyeing and Calico-printing, might possibly result from a Dyer's examination (on the spot) of the coloring properties of the vegetable productions of the Tropics.

It is possible that there are other plants in different countries, besides the Opuntia or Nopal, that afford this beautiful Red Dye; for I remember reading more than thirty-five years ago, in "Hawksworth's Cook's Voyages," a description of the arts practised by the Friendly and Society Islanders, wherein the narrator has very nearly these remarkable words: "The Natives prepare from a plant, a color so beautiful and which they apply to their garments, that Mr. Banks' Natural History Painter could only imitate it by mixing Carmine and Vermillion together.

Now this mixture of Carmine and Vermillion indicates a color of the most superb description, and far outvieing anything that we can produce from Cochineal; because our Scarlet Color is merely a Carmine Lake, and is not equal in beauty to a mixture of that Lake with Vermillion, or the Red Sulphuret of Mercury.

It will also be remembered that the above color was extracted or prepared from a Plant, and not an Insect.

AN ACCOUNT
OF THE
PROPERTIES AND COMPOSITION
OF THE
Dyestuffs and Chymical Compounds
WHICH ENTER INTO THE
CONSTITUTION OF COLORS.

INTRODUCTION.

The following Treatise on the Dyestuffs and Mordants of Colors may be considered as a necessary Appendix or Supplement to the treatise entitled "The System and Science of Colors, or the Principle and Practice of Woolen Dyeing, &c.," in fact, they are both embraced under the above Title, but are calculated either to go together or in separate parts, to accommodate the wants of particular individuals or professions.

Notwithstanding that the principles of Woolen Dyeing are avowedly the particular object of this Work, yet the Cotton and Silk Dyer, and also the Color-maker for Printed Goods, and even the Painter, or Dealers in Colors of any description, will find in this treatise a great amount of useful information relative to their respective branches of business, and to the Nature of Colors in general.

As this treatise may probably fall into the hands of some persons endowed with the advantages of a liberal education, and who may be disposed to criticize the style and diction of the author, I would respectfully observe to them, that it is not from the pen of a Scholar, but only from the hand of an uneducated Dyer, and is simply the plain description of subjects that have engaged the attention, and elicited the experience of the writer.

On this account, it is not to be criticised as the production of a learned Professor, but ought only to be viewed as the catch-time labors of an unlettered workman, indited from time to time for his own especial reference, and intended solely for the particular inspection of men of the same pursuits, studies and acquirements as himself.

And it must also be remembered that I had no written works to refer to, or any person to whom I could apply for the least assistance while composing it. I have trod the "Wine Press all alone;" therefore, whatever credit or censure may be attached to it, belongs to me and to *me only*. Richard Gibson.

MATERIÆ TINCTORIA:

OR A BRIEF ACCOUNT OF SOME OF THE SUBSTANCES EMPLOYED FOR PRODUCING COLORS WHICH ARE APPLIED TO FABRICS IN THE ART OF DYEING.

ALPHABETICAL ORDER OF THE DYE STUFFS.

Astringent-principle,
Archil,
Barwood,
Barks,
Bran,
Camwood,
Cochineal,
Cudbear,
Fustic,
Heath,
Hypernic Wood,
Indigo,
Lac Dye,
Logwood,
Madder,
Madder Roots,
Munjeet,
Nicaragua Wood,
Nut Galls,
Old Madder,
Peachwood,
Quercitron Bark,
Red Wood,
Roots,
Sanders,
Shumac,
Sulphate of Indigo,
Tannin,
Valerian,
Weld,
Woad,
Young Fustic.

I DIVIDE these matters into two kinds, or arrange them under two heads; because a color, being composed of two parts—the *Base* or *Mordant*, and the *Coloring-principle*, or that immediate material which gives a particular Color when united to the Mordant, seems to require that a distinction of this sort should be made when treating of the materials that enter into the composition of Colors, in order to mark correctly which of the two constituents of Color is afforded by any particular material employed in producing it; and also to enable the Student of this art to ascertain with little trouble what particular ingredient affords the Coloring-principle, and which forms the Mordant or Base of the Color he may wish to apply, or combine with a Fabric by the process of Dyeing.

For this purpose I arrange them in two Classes; one, I term *Dyestuffs*, being such Drugs as contain the Coloring-principle; and the other, under the head of *Chymical Compounds*, will embrace all those articles that constitute the Base or Mordant of the Color.

Such materials as are, in themselves really *Colors*, and, of course, have the *two* constituents of *Color* already united in their composition; say Indigo, for example; will be placed in alphabetical order without regard to the Class in which they may be found.

I shall say no more respecting any article than what I think will be of use to the Dyer, or what I suppose it may be necessary for him to know.

THE DYE STUFFS:

OR SUCH MATTERS AS AFFORD THE COLORING-PRINCIPLE.

A

Astringent, or Astringent Principle.—This is the same substance as *Tannin*, or that principle which, existing abundantly in Barks, gives the latter the property of Tanning Raw Hides into Leather.

It is one of the immediate materials of Vegetables, and is found, in greater or less quantity, in almost all Barks; the Husk or Rind of Walnuts, and other shelled fruit; and combined with Gallic acid, in Nutgalls; also in Shumac, and a great variety of other Vegetable matters; in Madder and other kinds of Vegetable Dyestuffs, of which Catechu contains the most.

On sucking with the mouth, any substance containing it, its presence is ascertained by the sensation called astringency, or the effect of *Puckering* or constricting the vessels of the mouth and throat; of which effect eating the Choke-Cherry (of America) is a good illustration; that wild Fruit contains abundance of it.

But astringency of taste is produced by some substances that do not contain any Tannin or astringent-principle; such as Alum and some other Acids, &c.; therefore, *taste* is not always a certain Test of the presence of this principle.

Tannin, or the Astringent Principle, does not Crystalyze, but forms by evaporation, or precipitation, a brown resinous looking substance which dissolves readily in water; this vitrious form serves to distinguish it from the true Coloring-principle, which is a Crystalizable body.

Although this principle is abundant in several of the Dyestuffs, and has a strong affinity for Wool, Silk and Vegetable Fabrics, and also yields Dun Colored Precipitates with the Mordants or Base of Colors, yet it is not *the* principle which is the cause of Color; and its effects must not be confounded with those of the true Coloring-principle, with which it is found so frequently associated.

It is true that the Astringent Principle, or *Tannin*, may aid in filling up, or giving body to some Dark or non-prismatic Colors, by the quantity of Dun or Tawny matter which it communicates; but where light and very bright Colors are required, it ought to be separated from the coloring-principle by means of Gelatine or Albumen, for the Dun shade which it gives would be injurious to the beauty of any of the Prismatic Colors whose brilliant hues are obtained only from a true Coloring-principle.

The chief use of the astringent Dyestuffs, such as Nut Galls, Shumac, &c., in Woolen Dyeing, is for Drabs and Dark Colors, and it is used with the Mordant as a ground work in Dyeing Blacks.

In Silk, but more especially in Cotton Dyeing, Astringent matters are more necessary and more extensively used than in coloring Woolen Goods; because the two former substances, not possessing so powerful an affinity for colors on their constituents as wool does, it becomes requisite to impregnate them with something that has a tendency to unite both with them and the color that is to be applied; this property is inherent in the astringent Principle; hence, its usefulness in all cases where but a feeble attraction exists between a color and the substance to be colored, for it serves as the *Bond* of a union, or the *Medium* of a combination that could scarcely have been effected without it.

ARCHIL.

Archil.—This article comes to the Dyer in casks containing a violet or crimson colored Liquor, and a large quantity of *weed;* this latter is the plant, or rather the moss, or Lichen from which the color of the Archil Liquor proceeds; it grows upon rocks in the Islands to the west of Africa, and is similar in appearance to the *Samphire* of the English coast.

To prepare it for the use of the Dyer, the plant is bruised and then thrown into a liquid containing stale Urine and Quick Lime, or a weak aqueous Ammonia is used for this purpose; after standing some days, both the plant and the liquor, now charged with color, are put into casks, and in this state the Dyer receives it; the older it becomes the better it is.

It gives very blooming, but very fugitive colors; consequently it is not much employed in Woolen Dyeing, and that only for particular purposes, such as the rosing or heightening of colors, or to communicate a Bloom to Indigo Blue, which, however, soon passes off, on which account it is not so much used now as formerly.

In order to employ it in Woolen Dyeing, all that is necessary is to throw some of the Liquid or the Liquid and Weed together, into clear hot water, and proceed as usual; it does not require much boiling, as the color works on, even without a boil.

Mordants are of no use with this substance, except as alterants of the shade; for none of the metallic or earthy salts increase its permanence in any perceptible degree.

The principal consumption of it is in Silk Dyeing; for producing Lavenders, Lilacs, and such colors as range between a Pink and a Purple, or for altering the tone of some other *more substantial coloring matters.*

B

BARWOOD.

Barwood.—This is a hard resinous wood, which grows in the Equatorial regions of Western Africa, and considered in relation to Dyeing, is of similar nature to Camwood and Sanders.

The color it gives is of a Bluer cast than the last-named woods, and of a poorer and more feeble intensity; the particles or molecules of its coloring matter being further apart, or being more widely separated from each other on the Dyed articles, than is the case in the color of Camwood or even Sanders.

This wood yields a coloring matter that is permanent, either with or without Saddening or Mordant, and it is much employed in Woolen Dyeing; more especially for the deep sombre colors; it leaves the wool less harsh than either Camwood or Sanders.

It is used altogether in the ground state, as the color could scarcely be extracted from it if used in the Chips, or enclosed in Bags; it requires considerable boiling to bring into solntion the whole of its coloring properties. These remarks apply with still greater force to Camwood and Sanders, which, being harder and more resinous woods, part with their respective Dyeing qualities with yet greater reluctance.

Alcohol, Alkalies, and matters containing Tannin or the Astringent Principle, such as Shumac, Nut Galls, &c., all aid or facilitate the extraction of the color of these Dye woods; but a very small quantity of any metallic or other salt dissolved in the water, is sufficient to prevent them from yielding up their properties to that fluid.

This hint will suggest to the Dyer, the necessary precaution of freeing the kettle from any remains of a former Dyeing before he fills it up with fresh water for another operation.

BARKS.

Barks.—These substances were formerly much used in Dyeing, especially for the darker colors;—as they all contain more or less

Tannin and other principles in common, which yield either with or without Mordants, a Dun, Fawny hue, that possesses considerable permanence; this may have been the reason for their extensive employment as a *Ground* or *Root* to brighter, but what were considered as less durable, Dyestuffs.

But as a decoction of Bark communicates much harshness to Woolen Fabrics, and the hue derived from it imparts a dead, lustreless appearance to a color, and as more expedient methods, brighter colors, and greater softness in the handle of the goods are now looked for, more than formerly, the employment of such articles would not only be injurious to the texture of the goods, but the colors so produced possessing neither character or lustre, could never be sold; and any person who should attempt coloring by such uncertain and wretched means, would manifest his ignorance and inexperience of the surer result and more brilliant effects of modern practice.

Therefore, the use of Walnut, Alder, Maple, Butternut and Hemlock Barks, Walnut Peels, Husks, and all such cumbrous and unaccountable materials for producing a color *that cannot be named until finished,* are now confined to custom clothiers and to such fellows as profess to be colorers, who, without any practical experience of the business, or the least knowledge of its principles, under the name of country Dyers, make awful execution at those Manufacturing Establishments that are so unfortunate as to employ such impostors.

None of the above articles contain the least particle of coloring-principle, and the combination of their extract, with mordants, never affords a Compound possessing the character, or worthy the name, of color.

There are no barks that can be judiciously or advantageously employed as a producer of color, (in the woolen dyeing) with the exception of Quercitron or Black Oak Bark; and that solely on account of the abundance and beauty of a true coloring-principle that it contains, independent of its other materials common to all Barks.

Non-coloring Barks may possibly be of use in Cotton Dyeing, as a medium of attraction for such colors or mordants as have but a feeble affinity for vegetable fibre; the dead hue and harsh feel given by it not being so perceptible on Cotton as on Woolen Goods; I do not say that it may not be of some little use, in small doses, in Silk Dyeing, for the same reasons; or a decoction of these articles may be used, (for want of other means) in Blue Vats for woolen, to neutralize, or precipitate any excess of alkali or Lime that may be present; but for any one to think of using them as coloring matters, is absurd and ridiculous in the extreme.

BRAN.

Bran.—This is too well known to need any description, further than to say, for the Dyer's use, it should not be fine, but coarse broad Wheat Bran.

If hot water be poured upon Bran and then left to stand, it speedily acquires acidity, and the acid thus formed is the Carbonic: it is this speedy formation of Carbonic Acid that makes Bran so useful and necessary an ingredient in the Woad and Ash Vats, not only as an assistant of the other articles in deoxydizing the Indigo, but also as a re-establisher of the fermentation, when that has been suspended by excess of Lime or Potash; the Carbonic Acid, precipitating the first, or neutralizing the last, when either are in too large quantity; by which means the proper equilibrium of the Vat is restored and the fermentative matters again resume their functions, and the operation proceeds as before.

Bran is also used, along with a little Alum, Sulphuric Acid, or a Solution of Tin, for clearing water of its impurities, previous to Dyeing brighter colors; the manner of doing which is described elsewhere.

C

CAMWOOD.

Camwood.—The Tree whose wood is known to us by the name of Camwood, grows in the countries contiguous to the Bight of Benin, and is of a similar nature, in its chymical properties, to Barwood, already described.

It is more abundant in coloring matter and produces a color more intense and of a more decided Red than Barwood; it is very extensively employed in Woolen Dyeing, the color it affords being remarkably durable, either without Mordants or with them.

The *Sadden* or Mordant of Solution of Tin, rouses or brightens up the shade, making it verge more towards a Scarlet or Aurora, than its natural color; Bi-Sulphate of Copper gives a handsome looking Claret; Proto-Sulphate of Iron, gives a Plum; Nitrate, or Nitro-Muriate of per-oxyde of Iron, gives a Chocolate; and Potash-Sulphate of Alumina (or Alum) produces a color between the shade given by solutions of Tin and that of the Bi-Sulphate of Copper; none of the Salts of Lime seem to produce desirable results upon it as a Mordant; the Bi-Sulphate of Copper produces the best effects upon the color of this wood, and appears to be the most proper and effectual Mordant for it in most cases.

Camwood gives out its color to water with some reluctance, but Astringents, Alcohol, and Alkalies cause it to dissolve readily in it; even one ounce of Sub-Carbonate of Soda (added gradually) for every ten or fifteen pounds of Camwood, towards the end of the boiling, and previous to entering goods to be colored (or the wool;) will make a very sensible difference in the quantity of color obtained, and the wool will work opener and better than if no Sub-Carbonate had been used.

The coloring matter of Camwood communicates a harsh and disagreeable feeling to the Wool or Cloth, and these colors never work quite so well, or feel so velvety as when less resinous Dyestuffs are used; but this objectional quality is not so great in Camwood as in Sanders.

For use, this wood is finely ground, and in this state is thrown loosely into the kettle, in which it requires considerable boiling before entering the material to be colored.

COCHINEAL.

Cochineal.—A valuable and highly prizeable Dyestuff, which was long mistaken for some kind of grain; hence, the color it produces with solotions of Tin, by way of eminence, was distinguished as Grain Scarlet, or Scarlet in Grain—a name which it retains in England to this day, as marking its superiority over Lac or any other kind of Red; but it is now known by all Dyers to be an insect.

It is a native of those parts of South America, bordering on the Great Gulf of Mexico, of St. Domingo, Jamaica, Cuba, and several other West India Islands, of Florida, Georgia, South Carolina, Louisiana, Texas, and Mexico,—in all of which places it is found wild.

It is cultivated in Mexico to a great extent—also, in some of the West India Islands; but the Mexican Cochineal is the best. It is a short-lived creature, which is sustained upon the juices of the Nopal or Opuntia, and when it arrives at maturity, say at two months old, it is shaken from the plants on to cotton sheets, and then put into boiling water, or upon hot iron plates, which kills it and causes it to shrink and shrivel up in the shape it comes to us as an article of commerce. In this state, in a dry situation, it will keep unaltered, in its properties, for an indefinite length of time.

I do not intend to assume the province of the Naturalist, by describing its appearance, habits, or the method of rearing it, &c.; for, in truth, I know but little about it, in these respects, otherwise than by hearsay reports; so I shall confine myself, as a Dyer, to a few observations regarding the Cochineal of commerce, and its application, in our business, as one of the most brilliant and valuable Dyes.

This article is presented to the purchaser in two kinds—the Silver and the Black Cochineal; the latter, as a general rule, is inferred to be the most valuable; but this is a nice distinction, and only holds good when the two kinds present the same specific resemblance; for a bold, clear Silver, is preferable to a Black of opposite appearance.

In making choice of either of these kinds, you must observe that each grain exhibits a bright, free, clear, bold, large appearance; whether the whole mass be free from dust, or small abraded parts of the insect, or matters foreign to its nature; and whether a quanty of it, poised in your hand (the most sensitive of all balances, in such cases,) has a certain weight, *feel*, or specific gravity—which any person much accustomed to, can distinguish with the greatest nicety.

Good Cochineal is known by the same features, in appearance, *heft*, &c., that good wheat is known by, and a good judge of wheat would also be a good judge of Cochineal.

For use, Cochineal is ground in mills of a similar construction to coffee-mills, and is then thrown loose into the kettle.

Cochineal contains fifty per cent. of a pure crystalizable coloring-principle, which it very easily parts with to boiling water, forming a well saturated solution of a deep crimson or claret color; it is, therefore, the richest in coloring-principle, of all the known Dyestuffs. Its clear and filtered solution, mixed in parcels, with different Mordants or Mineral Salts, &c., also in solution, present the following results:

Proto-Sulphate of Iron, slowly forms a Plum-colored deposit.

Nitrate, and Nitro-Muriate of Per-Oxyde of Iron, precipitate more speedily a Chocolate-colored Lake; the Nitro-Muriate the brightest.

Bi-Sulphate of Copper, a red Purple deposit; a portion of the color remains in solution.

Nitrate of Copper, a brighter color of the same character as the preceding, and the liquor not so much colored.

Nitrate of Mercury, a brown Chocolate sediment, and supernatent liquor lilac-colored.

Nitrate of Lead, a heavy Purple precipitate, and the liquor nearly colorless.

Nitrate and Sulphate of Zinc, pretty similar to the preceding.

Nitrate of Silver, dull, bluish Black precipitate.

Sulphate of Magnesia, no precipitate, and the color of the solution unaffected.

Nitrate of Lime, scanty precipitate, and the solution blued up to a Violet or deep Lilac.

Oxalic Acid turns the solution to an Orange color, and a scanty precipitate falls of an Aurora color.

Citric Acid, similar effects, only of a redder hue.

Super-Tartrate of Potash brightens up the solution, causing it to assume a fine Scarlet color, and after some time a slight precipitate falls, of a light Red.

Super-Oxalate of Potash produces more decided effects of the same character as the preceding.

Alum gives the liquor a fine Crimson appearance, and a moderate precipitate of the same color takes place, the liquor still retaining considerable coloring-matter, which a solution of Nitro-Muriate of Tin precipitates of a more decided Scarlet, leaving the residuary liquor of a pale Fawn color.

The remainder of the Cochineal liquor being now taken, and some of the Nitro-Muriate of Tin poured in, an abundant precipitation takes place, which, when settled, becomes a fine Carmine color, and the decanted liquor has a bright, deep Fawn color.

I forgot to state that all the alkalies cause the the Claret-colored liquor of Cochineal to pass to a deep Violet, with scarcely any, or very small precipitation; and even several neutral alkaline Salts, such as Muriate of Soda, &c., have similar, but feebler effect.

Other acids, not named above, act in a similar manner, with some variations, differing but little in their mean results from Oxalic and Citric Acids.

From these little experiments, we can perceive how the coloring-principle of Cochineal comports itself with the different Mordants, and the effects of Alkalies, Alkaline Salts, and Acids, as alterants of the shade given by any particular Mordant; we may also glean some useful practical hints, that may serve to guide us in the operations of Dyeing with this costly article, so as to produce the best effects, with the greatest economy of the material.

From these observations, we gather—

1st. That Super-Tartrate of Potash is useful, by causing Cochineal to give out its coloring-principle more completely to water, and that it turns its natural color more towards Scarlet, and the larger the quantity of Tartar, the more this latter color veers towards Aurora.

2d. Therefore, a definite quantity of this acidulous Salt is necessary in Dyeing Scarlet and its shades, not only to give the peculiar tone of Scarlet to the color, but also to create a greater quanty of it, by aiding the Cochineal to produce a more abundant precipitate of Color than it otherwise would: but, again, the quantity of Super-Tartrate must not exceed a certain proportion, because the roseate hue of the Scarlet is more and more changed towards Aurora, the greater the excess of Tartar over the just proportion.

3d. As our Scarlet color may be considered a compound of a pure Red or Carmine, and a small proportion of Yellow, and although we could communicate the necessary Yellow shade to it by working the Cochineal towards the Aurora, by using an excess of Super-Tartrate of Potash; yet we economize the consumption of that costly article, and obtain a more desirable color, by producing the Yellow part from a less expensive Dyestuff, such as Young Fustic, &c.

4th. Super-Tartrate of Potash is also necessary in Dyeing any of the shades of Crimson, from Pink upwards; but in a much less proportion than for the Scarlet hues, because all we want of it in this case is merely to spring the Cochineal, and still preserve, as much as possible, the bright Crimson tint natural to it. The proportional quantity of Super-Tartrate to the Cochineal, in these two cases, is about, for the Scarlet—5 Super-Tartrate to 5 Cochineal; and for the Crimson—3 Super-Tartrate to 5 Cochineal, (those parts by weight.)

5th. That solutions of Tin are the only proper Mordant or base for the Scarlet shades, of which solutions, the Nitro-Muriate is the best; and that Alum, with an equal weight of a well saturated solution of Nitro-Muriate of Tin, is the best Mordant for Crimson shades.

6th. That none of the other metallic Salts used as Mordants, with Cochineal, produce any better colors than can be obtained from less expensive materials; so they are no advantage in the application of Cochineal as a Dye.

7th. And that all Alkalies, Alkaline Earths, and even some neutral Alkaline Salts, blue up the Cochineal colors, making the Scarlet appproach the Crimson, and the Crimson pass to the Purple shade. The brilliant colors given by this substance are remarkably sensitive to Alkaline proximity; for they will indicate by their change of shade, so small a quantity of Alkaline presence as almost to warrant their employment as *tests* of alkalinity. These alterants are, therefore, employed for the Heightening, Rosing, or Blueing of Pinks, Roses, Crimsons, &c., for which purpose Ammonia is generally used, as producing the brightest and most desirable effects.

8th. That all Acids, and even Acidulous Salts, cause the colors from Cochineal to pass from the Crimson to the Aurora or Orange hue, in proportion to the quantity of real acid strength acting upon them; or in proportion to the power of the particular acid to communicate to, or abstract Oxygen from, the Cochineal color.

The Oxalic, Nitric and Muriatic Acids in excess, change the color of Scarlet to a deep Yellow, which can never be restored to Scarlet again, by any known means: notwithstanding this, the Cochineal Color bears a great acid power before it is much injured.

According to M. M. Pelletier and Caventou, the products of Cochineal are—

1. Carminium (the pure coloring-principle.)
2. A peculiar animal matter.
3. A fat matter, containing stearine, elaine and odorant principle.
4. Salts, Phosphate of Lime, Carbonate of Lime, Muriate of Potash, Phosphate of Potash, Potash united to an organic Acid.

"Dr. John, of Berlin, calls the red coloring matter Cochinilin. He says the insect consists of—Cochineal, 50; Jelly, 10.5; wavy Fat, 10; Gelatinous mucus, 14; Shining matter, 14; Salts, 1.5, in every 100 parts"—A. URE.

Its ultimate constituents, from Dr. Ure's "Table of Organic Analysis," are, Carbon, 50.75; Hydrogen, 5.81; Oxygen, 36.53; Azote, 6.91=100.

CUDBEAR.

Cudbear.—This is a fine powder of a Lilac color; it is made from the same plant employed for the liquid Archil, and may be considered as Archil in a gross and dry state. For its preparation, the plant is sprinkled with Ammonia, or with stale Urine and Lime; or Soda or Potash is also used, (different manufacturers employing different articles and dissimilar processes to effect the same end,) and when it has become sufficiently impregnated with the Alkaline preparation, it is dried and then reduced to powder, and packed in barrels for sale.

The color given by this article is less bloomy, but more durable than Archil; but still it possesses little permanence.

Before putting it into the kettle for use, it requires to be made into a kind of paste, either with hot water or the hot liquor of the kettle, so as to moisten all of its fine dust, to prevent its floating.

The purposes for which it is employed in Woolen-Dyeing, are to communicate a bloom to Indigo Blue; to form the red part of some Lavenders, Lilacs, &c.; to body or fill up Crimsons, &c., so as to economise Cochineal, at the expense of the beauty and durability of those colors; it is, also, used to obtain a Puce or Peach Blow for Mixtures, and other purposes.

Mordants are of no use with this article, although a quantity of Super-Tartrate of Potash, not exceeding one-fifth the weight of Cudbear, brightens up the hue, and makes it resist the operation of scouring and fulling better than it would were this omitted.

Archil and Cudbear colors fade rapidly by the action of the sun's rays; by heat and by light; passing speedily from the natural shade to a dead Fawn: therefore, in order to preserve their beauty, they should be dried at a moderate heat, and in the shade, and carefully preserved from the rays of the sun.

These observations apply to fugitive colors in general.

F

FUSTIC.

Fustic.—The tree whose wood is known to Dyers by this name grows in the islands and on the main land of the Gulf of Mexico; that from the island of Cuba is the best.

For the Dyer's use, it is either chipped or ground; and as the color of Fustic deteriorates by age or exposure, the sooner it is used, after it is thus prepared, the better.

It does not give out its coloring-matter to water so easily as Logwood, nor yet with such reluctance as Camwood, or the resinous Dye-woods of the same nature; consequently, it requires much more boiling than Logwood, but not quite so much as Barwood, &c.

The color of its watery decoction is a deep brownish Yellow, and when in great strength has a syrupy appearance, and hangs from a stick, &c., like slime; all the Acids brighten the color of this decoction, turning it more towards a Lemon shade; all the alkalies deepen it, making it assume a deep Orange color; in both cases, a slightly flocculent sediment settles in time.

All the Mineral Salts usually employed in Dyeing, form precipitates or Colors with it, varying in their shades from Yellow to Olive, according as the base of the particular Salt is more or less colored: thus, Alum and solutions of Tin, whose oxydes and earth are both white or nearly colorless, produce a tolerably bright Yellow; while the Sulphates of Copper and Iron, produce, the one a green Olive, the other a brown Olive; Nitrate of Per-Oxyde of Iron, an Olive so deep as to appear Black, the bases or Oxydes of these latter Salts being progressively deeper colored.

Fustic is almost an indispensible article in Woolen-Dyeing, for it is used in almost all those compound colors, into whose composition a Yellow enters; and as it is both cheap and gives durable colors, either with or without Mordants, we cannot very well meet with a substitute for it.

A very strong decoction of Fustic may be advantageously employed in the Blue Vat to neutralize or precipitate an excess of Lime or Potash.

The decoction of Fustic, besides the coloring-principle, contains Extractive matter, Tannin, &c.

The Tannin or Astringent-principle, can be rendered inert and precipitated by Gelatine or Albumen, when a brighter and more abundant color is obtained.

The Yellow given by Fustic is much inferior in beauty to either Quercitron, Weld or Heath; but it is a very permanent color, almost equalling Weld in durability, and far outlasting the Yellow of Quercitron, on which account it may be employed for Listing and common purposes with advantage.

The soluble matter of Fustic combines very intimately with Woolen fibre, and is reported to render the Wool rather harsh and tender to work. Perhaps this is not without foundation where colors, such as Olives and Browns, requiring a very concentrated solution of it are concerned; but I do not know what kind of Dye-stuffs we could employ to produce such saturated and deep-bodied colors, that would not have the same effects; for I believe it is not so much in the quality as in the quantity of the coloring matter absolutely necessary to give such intense and heavy colors their utmost brilliancy.

H

HEATH.

Heath or Heather.—This is a shrub, having a hard, woody stem of about a foot in height, growing spontaneously on the mountains and waste lands of the British Isles. It is a hardy plant of a brown appearance, and being the principal vegetation of the uncultivated parts, communicates a russet hue to the scenery of the tracts that it covers.

This plant produces a Yellow, which for beauty is nearly equal, and in durability nothing inferior, to Weld.

The method of Dyeing with it was known to but a few of the English Dyers; and those, keeping the knowledge of it to themselves, engrossed, for several years prior to 1820, the entire coloring of the Flannels for the American market; but the Quercitron Bark, and the less trouble of Dyeing with it, tempted them to substitute the latter for the superior and more durable Yellow of the Heath, and it was finally laid aside, except for some particular purposes.

The method we employed for coloring with it was, in the first place, to cut down the plant and dry it; then enclose a large quantity of it in a coarse bag and boil it about four hours, at the end of which time we gave it a quantity of Super-Tartrate of Potash, Alum, Nitro-Muriate and Muriate of Tin; boiled about twenty minutes longer, and then withdrew the Heath; commenced Dyeing by running (if manufactured goods) a small kettle-full, (6 Flannels,) with great expedition and dexterous handling for about fifteen or twenty minutes, when they were taken out, and more introduced and treated in the same manner, and so on with successive quantities, until the liquor was exhausted of color.

This was a rough and coarse way of Dyeing, and required considerable manœuvering to get the different Dyeings all to one shade, which was a necessary thing; and also to have the first ones perfectly even, which was no small affair, considering the rapid manner in which the color took. I can now perceive how all these defects might have been remedied, and the color have been made to combine by a steady and uniform mode of Dyeing.

Wool could be Dyed Heath Yellow, by the common and usual method, as for other colors.

I have not had the opportunity of making many experiments on the Sweet Fern of this country, but I think it would produce similar effects to the Heath.

HYPERNIC WOOD.

Hypernic Wood or Lima Wood.—As the continent and contiguous islands of South America afford us several woods that give a handsome Red, such as Hypernic, Nicaragua, Pernambuco, Brazil wood and Peachwoods; which, in relation to Dyeing, may be considered as only different names for Dyestuffs producing a similar coloring effect, and only differing in some little particulars, not essential to separate classification, I shall make one description answer for all these substances.

Hypernic or Lima wood, comes from that part of South America, indicated by its name; it is a hard, solid wood, and for the use of the Dyer is ground, and then sprinkled with Urine and water, or a solution of Soda, and a kind of incipient fermentation given to it, during which it acquires a certain degree of heat, which requires some care and skill on the part of the Dyewood grinder to regulate. When this operation has been rightly performed, the article will then easily give out the whole of its coloring-matter to water, presenting a rich deep liquor, of a Crimson color, which Acids and Acidulous Salts will change to Orange, and Alkalies turn to Purple. Solutions of Tin precipitate from it copiously a bright red-colored Lake; and Alum throws down slowly a bright and clear Red.

Nicaragua or Peachwood does not afford so deep a crimson-colored liquor, neither is it so rich in coloring matter; but it is better adapted to coloring common Reds than Lima wood; and this latter is better for Garnets, Rubies, Maroons, &c., on account of the deep Crimson shade it naturally communicates.

For use, the ground wood is thrown loosely into the kettle and boiled a few minutes; the boiling is checked, and the article to be colored (having received a preparation before) is entered, and in from thirty to sixty minutes it is finished.

A very small quantity of Sub-Carbonate of Soda, with the wood, so as to give the liquor a full Crimson color, (but no more,) is of benefit in aiding the combination of the coloring-matter with the Aluminous Mordant, by seizing any excess of Acid present.

The dose of Sub-Carbonate of Soda, may be much larger for the Crimson shades than for Reds.

If the Reds are to be much on the Scarlet shade—that is, are to have a flame color—then some ground Fustic, not exceeding one-eighth the weight of Pernambuco or Nicaragua, may be used with the latter.

The best preparations for Reds, from these woods, is Alum and Tartar; the Tartar in quantity about one-eighth the weight of Alum—some good Dyers use as much as one-fourth of Tartar, but this quantity is liable to give duller colors, as the Super-Tartrate of Potash works the Red of these woods too much on the Fawn color.

For Crimson, Garnet, Ruby, &c., I prefer a preparation made with Alum and one-eighth its weight of Super-Tartrate of Potash, and the same quantity of Bi-Sulphate of Copper.

I have tried the solutions of Tin, both with and without Alum, and I find them rather injurious than beneficial as Mordants for these Dye-woods, when coloring Woolen goods.

The Colors given by all these woods possess no great degree of durability; but they are used for Listing, Coarse goods, and common low-priced colors and articles.

The best temperature to commence Dyeing these colors, (when the Aluminous Mordant is used,) is about 170 degrees, and bring up to a boil, which continue no longer than to obtain the shade sought for.

I

INDIGO.

Indigo.—The plant from which Indigo is extracted is a native of the hottest portions of the globe. It grows wild in Central Africa and South America. There are several species of it; one of which I have seen extending itself to the 42d degree of North latitude.

The variety from which the Indigo of Commerce is obtained, is a cultivated plant; and is seldom, outside the Tropics, productive of color valuable enough to pay for the expense incurred in its cultivation.

In those countries where it is successfully reared, the plan for obtaining the Indigo is nearly as follows:

The plant is taken and thrown into a Vat, and a quantity of water is run upon it; in this it undergoes a rapid fermentation, which has the effect of bringing its color, with the soluble parts of the plant, into solution; this charged liquor is then drawn off the plant, into another Vat, placed lower than the first one: the liquor, now in the second Vat, receives a beating with buckets fastened to the end of poles, in order to knock down or separate the Indigo from the more soluble and less solid matter in the liquor; and sometimes Lime is added to the liquor, to promote the same object: when the beating has been long enough continued, it is left to settle, and when all the precipitate has collected, the supernatent liquid is run off; and the Indigo, now in a pulpy state, is drawn off into cotton strainers to drain out its redundant moisture, and when it becomes a stiff paste, it is then put into little square boxes, and further dried by exposing them to the air, under open sheds. In this shape it comes to us; and this simple mode of manufacturing it, has probably been in use from time immemorial.

We have now to treat of it as one of the most important and valuable materials employed in the Art of Dyeing.

This article is a Lake, Precipitate, or Color; and not simply a Coloring-principle, which requires a Metallic Oxyde to combine with it, in order to produce the coloring effects; but it is, in all probability, of the same compound nature as other real Lakes or Colors, and has existing in its composition, two distinct substances —an unascertained coloring-principle, and an unknown base or Metallic Oxyde.

In this respect it differs from all other materials employed for fast Dyes; the rest being either substances containing the coloring-principle only, or matters that serve merely as the Base of Colors.

On exposing common Indigo to a heat of between 500 and 600 degrees, it gives off a beautiful Crimson-colored vapor, which, on being condensed, forms splendid Purple-colored crystals; these are the pure or absolute Indigo Color; and that the bright black coal which remains in the apparatus, is not any portion of the real, pure Indigo that has been Carbonized, is proved by the crystals obtained being equal in coloring effect, to a quantity of common Indigo equal in weight to that which was exposed to sublimation, and the coaly residue will afford no color by any means whatever. This will convey my meaning when I say pure Indigo, or pure, real, or absolute color of Indigo, &c.

The Indigo of Commerce presents various appearances as to color, weight and texture; this dissimilarity is owing more to the variable proportions and nature of the foreign matter, and the greater or less quantity of absolute Color present in the several specimens, than to any real difference in the quantity of the pure Color; for on subliming samples of common Indigo, differing ever so much in appearance from each other, the resulting crystalization is the same in every respect, except quantity; therefore, positive color is of one uniform character, but as variable in proportion as there are discrepancies in the specimens; and the difference in effect, observable in Dyeing from different samples, is to be attributed to the particular quality and peculiar nature of the foreign matter constituting the gross Indigo, rather than to any variableness in the properties of the real color which it contains.

The colors of Indigo vary from a light China Blue to Purple and Coppery hues, some being bright and bloomy, others, again, flat, dull and greenish. The Weight, or specific gravity, ranges from 1635 to 1900; water being called 1000; the texture or fabric, from a chalky softness and mellow cleavage, to a hard, flinty brittleness and gritty fracture.

Out of such anomalies, the advantage and economy of the purchase consists in making a judicious choice, and pitching upon such specimens as will yield the greatest quantity of color, (or do the most work,) in proportion to the price at which they are offered for sale.

This is a point requiring the nicest discrimination, and cannot be made by any other person than the one who, from long acquaintance with the use of Indigo, has acquired an experimental knowledge of the powers of its different varieties.

This person is the Dyer; and he alone, of all others connected with factory establishments, has got the experience necessary to decide what particular Indigo will be most profitable to purchase; or which to reject, as not being adapted to the particular kind of work then doing.

Manufacturers would, therefore, do well if, instead of depending upon their own judgment, (which, from want of practical experience, must of course be defective,) they were to make use of the more perfect knowledge of the Dyer, in the purchase of their Indigo, and all other Dyestuffs.

To render this as saving and effective as possible, advantage should be taken of the market; the Dyer should be sent at proper times to such places as have the greatest quantity and variety of articles for sale; where, out of a great number of specimens, he may have an opportunity of selecting the best, or most profitable for any particular kind of work.

I am well aware that this course has not been the one employed in purchasing such momentous items as Dyeing materials; but any establishment, "knowing what belongs to its peace," will not fail to apply this mode as a prevention to imposition, and to avoid the fatal consequences of purchasing such costly articles without a knowledge of their relative value.

The large Dyeing establishments of England and France, depend for their very existence, upon a just estimate of the real value of the Indigo and other articles they consume; but the owners of those establishments, being themselves Dyers, and doing their own purchasing, are too good judges to be deceived.

This is not the case in this country: the owners of Dye-houses here, not being Dyers, but capitalists, and as such being practically unacquainted with the amount of difference in the several sorts of materials employed in Dyeing, are liable to be grossly imposed upon, if they undertake to buy on the responsibility of their own judgments; which is a ruinous affair, if persevered in for any length of time. The only person who can purchase Dye Wares, with any degree of safety or profit, is the individual whose profession qualifies him for the office—it is the Dyer.

I have wandered considerably out of my track, from a sincere desire to have the Dyeing establishments of this country equally economical with those of other nations; but this can never be the case, where the materials used in them are chosen by persons uninitiated in their respective values and properties.

I return from this digression, to that part of this subject which more immediately concerns you and I, as Dyers.

Among such a variety of Indigoes, presenting such difference in appearance, it is impossible to lay down any particular or definite rule of choice; and a practical eye and mind only, can determine which will answer the best for such and such kinds of work: all that can be here done is to notice some general and obvious features, as distinguishing a tolerably good consuming article; and these are: that its color should be bright and incline to the Purple, (for general purposes,) its weight, or specific gravity, from 1,125 to 1,257, and its breakage should be velvety, and present no brittleness or gritty, shining particles in the fracture, and it should have a glossy and coppery appearance, when rubbed.

The better kinds of Indigoes are more tractable than the inferior sorts, and dissolve more readily and with less trouble in such menstrua as are employed for their solution.

The lightest and most buoyant kinds are generally used for making the Sulphate of Indigo, such as Spanish Float; but I have invariably found a heavier and violet-colored Indigo of the East Indies, to answer better for this purpose.

For use, Indigo is ground dry, and to a very fine powder, for Sulphate of Indigo; and wet, to a smooth, oily, pulpy fluid, for the Blue Vat.

The Indigo of commerce is a compound, insoluble in every fluid except concentrated Sulphuric Acid, and it only dissolves in, or combines with, this powerful Acid, by virtue of a change effected in its nature, through the more powerful affinity of the Sulphuric Acid for the combined water of the Indigo, which in this case is the medium of combination between the two.

Indigo does not contain more than from 10 to 15 per cent. of pure, or absolute *Color;* for the best sample of Bengal Indigo that I ever used, by an experiment very carefully performed, gave me the following results, in 100 parts:

First—Purple Crystals, 14 parts.

Second—Carbon, 58 parts.

Loss, 28 parts.

This loss, I conjecture to have been chiefly Carbonic Acid gas, as it gave great precipitates when received into Lime water or solution of Acetate of Lead.

Third—I next burnt the Charcoal, which left 39 parts of ashes of a Fawn color.

This experiment differs widely from the analysis of Indigo in the humid way, by some of the most eminent Chymists.

Bergman gives, in 100 parts—

Mucilaginous matter, 12.

Resinous matter, 6.

Earthy matter, 22.

Oxyde of Iron, 13.

Indigo, nearly pure, 47=100.

Chevruel makes nearly the same account of the parts soluble in water, Alcohol and Muriatic Acid; and 45 of pure Indigo.

Thus, both these gentlemen—the accuracy of whose analysis cannot be disputed—give nearly one half the weight of pure Indigo, as the coloring-matter of the Indigo of commerce; but it must be remembered that they obtained only a Blue Powder, and not the crystalizable Colors; and there can now be no doubt on my mind, that had this 45 or 47 per cent. of Blue Powder been exposed to a subliming temperature, they would not have obtained more than from 12 to 15 of crystals of Indigo, which would have produced as great an effect in coloring as 100 of the crude Indigo, from which it had been separated.

From the mode of analysis adopted by Messrs. Bergman and Chevruel, I have gathered a practical hint for purifying, or rather, separating a great part of the foreign and detrimental matter of the Indigo; and as I have frequently had recourse to it for delicate purposes, and found great advantage from the process, I here subjoin the method I make use of.

For every part (by weight) of Indigo, previously ground, I take 20 water and 1 Potash, and boil these together three or four hours, keeping up the quantity of water; let it settle, and pour off the liquor; then add the same quantity of water as a wash for the Indigo; let it settle again, and then pour off the water; now add a second time, 20 parts of water, 1 part Muriatic Acid, 2 Alcohol; let this stand cold, in a closed vessel for 24 hours, agitating it at intervals; then raise the temperature to 160 degrees, at which heat preserve it for two or three hours; filter, and then wash off with 10 or 20 parts of water, rendered slightly alkaline by a small quantity of Potash.

Indigo, by this treatment, loses from 20 to 30 per cent., and the remaining color is much improved in quality.

The liquor employed dissolves none of the real Indigo, nor in any wise injures its color.

The matters carried off by the Alkaline and Acido-Alcoholic solutions, are only such as are useless in Dyeing, and always serve to deaden the brightness of the color that Indigo would otherwise give.

By this means, I have obtained Saxon Blues nearly as bright (but not as durable) as Prussian Blues; and very inferior Indigoes are made to produce as good effects as the best.

This process is of no service or advantage for the fast Blues of the Vats; as the foreign matters are not brought into solution in them.

The ultimate constitution of Indigo, and the proportion of its constituent principles, according to Dr. Ure, of Glasgow, are:

Carbon, 71.37; Hydrogen, 4.38; Oxygen, 14.25: Azote, 10=in 100; Water, 16; excess of Hydrogen, 2.52.

Note.—For further particulars of Indigo, connected with Dyeing, see Article, "Science of Colors," and subject Indigo; and also see the description of the Blue-Vat.

L

LAC DYE.

Lac Dye.—This comes to us from the East Indies, and is the production of an insect, (coccus lacca,) which, in the first place, deposits upon the branches of a tree, the cellular substance called Stick Lac, from which the Lac Dye of the Dyer is extracted.

As I am not acquainted with the particular method now adopted in the East Indies for preparing the Lac, in its present superior style for the Dyer's use, and as the Stick Lac, Seed Lac, and Shell Lac, are not employed in Dyeing, (the two last being merely the resinous portions of the Stick Lac, from which the coloring-matter has been separated,) I shall therefore pass these matters over, and proceed at once to describe the coloring material, Lac Dye, as it comes to us.

This substance came into use more or less in the English Dye-Houses about 45 years ago, and its first introduction was in the state of Lac Lake, which is the coloring-matter of the Stick Lac, precipitated by Alum; it is of a fine pink color, but the Lac Lake containing a considerable quantity of the resin of the Stick Lac, as well as other matters of an earthy or glutinous nature, it was not only very difficult to obtain a decent color from it, but the goods had a harsh, clammy, stiff, and disagreeable feel, and dirty appearance, it being impossible to wash such sticky and insoluble matters from the Cloth.

It was quite another thing to color with Lac, in that day, to what it is at present; for Dyers have been gradually improving in their methods of freeing the coloring-matter from its resinous associate; until now it is rare to meet with any gummy Lac; but yet occasionally we do get such an impure and troublesome article in the market.

In such a case, the best way of freeing it from the resin, is to dissolve the ground Lac in about ten or twelve times its weight of water, to which has been added a fourth as much Sulphuric Acid as there is (in weight) of Lac. Let this stand from 24 to 48 hours, stirring it at intervals; and then use it in Dyeing with the other ingredient, in proportion to the quantity of dry Lac contained in the solution.

Lac Dye appears in Commerce in the form of chocolate-colored cakes, of a firm texture and smooth fracture; and as it differs in its qualities and appearance as much as Indigo, it requires an experienced and competent judge of its relative values, in order to purchase it to advantage; as in the case of the last-named article, the Dyer has been pointed out as the proper person to make a judicious choice, so in this material, he also for the same reasons, should be employed as the purchaser.

Good ground Lac will be, or should be, an impalpable powder, with a smooth and fine handle, like wheat flour, having no grit, or sandy feel; it will have few or no shining particles in it; neither will it have the granular appearance of gunpowder. When mixed with an equal, or rather larger bulk or volume of Nitro-Muriate of Tin, it will form a bright red colored, stiff and smooth paste, of considerable tenacity.

The cakes of Lac are reduced to powder in a mill, and this, for the immediate use of the Dyer, is mixed into a paste with some of the solutions of Tin; if with the Nitro-Muriate, (which is the best solution,) no water is necessary; but if the Murio-Sulphate be employed, dilute it with an equal bulk of water, and suffer the paste to stand about twenty minutes, before putting it into the kettle; then boil the liquor in the kettle till all the materials are incorporated, and commence Dyeing.

Lac bears, and requires, longer boiling than Cochineal, in the process of Dyeing; it does not give so beautiful a color as Cochineal, but it withstands the action of Acid and Alkaline tests better, and it retains its peculiar beauty, or resists light and the atmosphere, longer than the color of Cochineal.

But a color equally as desirable, in some respects, as that entirely from Cochineal, can be obtained by using two-thirds the usual quanty of Lac, Dyeing for three-fourths of an hour, taking out the goods; then filling up the remaining one-third of the color with Cochineal and Solution of Tin; boiling twenty-five minutes longer, and then washing off, first in water, then in Fuller's Earth.

Lac does not contain more than one-half or two-thirds the quantity of coloring-principle that Cochineal does; and as the other gross quantity is matter injurious to, or of no use as, a coloring substance, this is sufficient to account for the difference in beauty of the two Reds of Lac and Cochineal.

The introduction of Lac in Dyeing, has tended greatly to keep down the price of Cochineal, as it is furnished in greater abundance, and at a cheaper proportional price.

LOGWOOD.

Logwood.—The tree whose wood, under the name of Logwood, is now so extensively used in Dyeing, grows to a large size in some of the West India Islands, and also on the Spanish Main. Its wood is very heavy, hard and firm; of a mixed color, having veins of Red, Aurora, and Plum, intermingled; but the greater portion being a reddish Yellow, which may be considered as the prevailing shade. The whole color of the wood grows deeper and more decidedly Ruby-colored by exposure to the air and moisture.

For use, this wood is either ground or chipped; in either case, it is advantageous to sprinkle it with Urine and water, or with a weak solution of Soda; and it ought to be chipped or ground at least three months previous to using it, as it acquires better coloring properties by age, probably by absorbing either Azote or Light, or both.

The chipped Logwood, is, in general, boiled in bags, and the ground is thrown loose into the kettle; when it very speedily and abundantly gives out its coloring-principle, with its other soluble matters, to boiling water, which it tinges of a deep Crimson, inclining to Purple. It is easy to change the color of this solution from its natural shade; by Alkalies, to a Purple; and by Acids, to an Orange.

Almost all the Metallic and Earthy Salts cause abundant precipitates or Lakes, with its solutions; the colors of which vary from Violet to Black, and in all cases preserving a tinge of the Violet hue; so that the solution of Logwood always throws down a compound color, whose proportions of Red and Blue vary with the different metals employed; and each metal gives deeper shades, according as it is more or less oxydized.

Tin alone, of all the metals, gives it the property of resisting Acids, and by taking a proper course with a Mordant of Tin, I obtain a Purple, as durable as Indigo-Blue.

Alum always gives Violet-colored shades. This wood is almost indispensable in our present modes of Dyeing, as it enters into all colors that have any tinge of Violet in their composition—such as Drabs, Leads, Slates, all the Violet shades, Plums, some dark Browns, &c.; but its chief consumption is in Olives, Logwood Blues and Blacks, to which it communicates a softness and glossy lustre, unequalled by any other material; and as it gives, when the shade is very deep, a tolerably durable color, it is much employed, even when the wool is very fine and costly.

The Mordant or Sadden, which gives it the greatest degree of permanence, is Sulphate of Iron—that is, in all the colors enumerated above, with the exception of Violet, when the solutions of Tin become the proper Mordant.

The combining proportions of Sulphate of Iron and Logwood, are, as a general rule, 7 of Logwood to 1 of Sulphate of Iron;—that is, we will suppose ourselves to be Dyeing a certain quantity of Wool common Black, which shall require 28 lbs. of Logwood in the Stuffing operation; then for the Sadden or Mordant, 4 lbs. of Sulphate of Iron will be all that is required, and would produce the same depth of color, as though we had used three times the amount of Sulphate; and why is this so? It is so, because the coloring-principle of all Dyestuffs combines in certain and definite proportions with all Salts capable of forming precipitate or Lake, with the coloring-principle, in as positive and determinate a manner as the different metals require different proportions of the several Acids for their saturation; that is, there is a Law of Prime Equivalents, or a Scale of Combining Ratios, according to which the Coloring-principle and the Metallic Salts (or their radicals) enter into combination and mutually saturate each other; the result of which definite combination, is the production of a specific quantity of Color. To illustrate this more clearly: Suppose, instead of the 28 lbs. of Logwood and 4 lbs. of Sulphate of Iron, we give 35 lbs. of Logwood and the above quantity of Sulphate, we shall obtain precisely the same results as when 28 lbs. of Logwood only were used with the 4 lbs. of Sulphate; but now let us take 35 lbs. of Logwood and 5 lbs. of Sulphate, and we shall obtain one-fourth more Color.

Now let us change the process, and instead of using 28 lbs. of Logwood and 4 lbs. of Sulphate of Iron, we will take 28 lbs. of Logwood and 5 lbs. of Sulphate of Iron. In this case, we obtain no more color by using the 5 lbs. than we do by using the 4 lbs. of Sulphate of Iron, because all the coloring-principle of the 28 lbs. of Logwood has been precipitated (or saturated) by the 4 lbs. of Sulphate, and the other odd pound remains in excess, as an inert, useless, and injurious surcharge.

But now let us make the 28 lbs. of Logwood into 35 lbs. (the proportional quantity for 5 lbs of Sulphate of Iron,) and we shall obtain a quarter more color, than we did by using 28 lbs. of Logwood and 4 lbs. of Sulphate; or than we could do, by using 28 lbs. of Logwood and 5 lbs. of Sulphate.

Thus, in order to increase the quantity or depth of color one-quarter, (or any other proportion,) we have to use a quarter more of each of the ingredients, and not simply a quarter, or even a half, of one of them.

This serves to show that the proportions of Logwood and the Sulphate of Iron do (in Nature) bear, and must (in Dyeing) be made to bear, a just relation to each other.

And this holds good, not only as regards Logwood and Copperas, but with Logwood and Sulphate of Copper, and every other Metallic Salt. And, also, it is a general law, which regulates the combination of all other Dyestuffs with all other Chymical Compounds or Mordants, and determines the quantity of their precipitates or color.

If a well saturated decoction of Logwood be evaporated, a deep Plum-colored Magma, of a very tough and tenacious consistency, is obtained; this is the Extract of Logwood.

On drying this Extract thoroughly, it shrinks to a deep-colored, resinous looking mass, brittle and of a very bright and glossy fracture, and having a remarkably saccharine taste.

On treating this latter with Alcohol (as detailed elsewhere,) we obtain the pure-coloring principle of Logwood, in the form of Crystals.

The Extract of Logwood possesses the same properties as the decoction, and is in comparative strength to good Logwood chips as 1 to 7; one pound of the Extract being equal to 7 lbs. of rough Logwood; and the combining proportions of the Extract and Sulphate of Iron are equal quantities by weight.

The employment of this Extract, in Woolen Dyeing, is of very little advantage, as only weak decoctions of coloring-matter are required for this purpose; but it may be of considerable use in Cotton, and even Silk Dyeing, and unquestionably in Cotton, Silk and Woolen Printing, because in these different branches or forms of Dyeing, the liquors have to be well saturated, or even concentrated solutions of the Coloring-matter.

M

MADDER.

Madder.—The plant (Rubia Tinctoria) to which we are indebted for one of the most permanent Dyestuffs, grows more or less, or rather is, or has been cultivated, in most of the European countries, as high as 53 degrees North latitude; also in Turkey in Asia and Egypt, and other places of North Africa. It either is, or ought to be, cultivated in the United States, whose climate is well adapted to the raising and drying of it.

The Dutch is the best of European Madders, but the Levant or Turkish Madder excels that.

The Madder of Commerce is the ground-roots and stem-roots of the plant, which receive various kinds of dressings and assortings that assimilate them into the different qualities or kinds distinguished in the English language as Crop, Gamene, Ombro, and Mull Madders, which rank in goodness (or value) in the order of their names. They are all in a state of a coarse powder, varying in color from a Yellow Red to a dull Brown.

As a dyeing material, Madder is of great importance and extensive use; it is an indispensable ingredient in Blue Vats for wollen goods; it enters into the composition of Drabs, Browns, Olives, &c., and had formerly a great consumption as a Red Dye; but the introduction of Munjeet, with the low price of Lac and Cochineal, and the public taste for more splendid colors, have thrown the Madder Red into the shade, and it is now seldom called for; although Madder produces as permanent a common Red, as Indigo does a Blue.

Madder is a bitter-sweet; and in accordance with these two principles, it seems to possess two kinds of coloring matter—one, a true Coloring-principle, and which gives a red with alum; and the other of an astringent nature, which yields only dun or fawn-colored precipitates or Lakes. These two substances are almost inseparably united, and the colors obtainable from Madder may be considered as the effect of both; hence in the process of Madder Red Dyeing, nicety of management is required, in order to obtain as much of the Red coloring-matter as possible, and as little of the Dun.

In consequence of this complex nature of Madder, very little boiling can be given to it, where a bright Red is required; but, on the other hand, this very composition is the cause of its admirable adaptation to the Blue Vat.

For the purpose of Red-Dyeing, and the use of the Blue Vats, the best Crop Madder only, ought to be taken;—for Drabs, and such colors, the Mull Madder; and the intermediate qualities of Gamene and Ombro, for the Browns, Olives, &c.

Madder should always be kept in a dry place, as it readily absorbs moisture, which speedily injures it greatly;—when thus kept it improves by age. Its age may be ascertained by the appearance of the head of the cask, which protrudes in a convex manner, through length of time, by the expansion of the enclosed material, from the force of its incipient fermentation. The *quality* is judged of by inspection, comparison and the taste.

By age it also passes from the state of a loose powder to a compact, crusty, and coherent mass; and the more thoroughly this change has taken place in the cask, the better is the article, in comparison with others that have not assumed this characteristic.

This solidifying property is an indication of good Madder; and as it progresses towards this state, it is said *to grow;* or if the process be completed, the term *well grown* is applied to it.

Sometimes, in the middle of an apparently *well grown* cask, you will meet with a quantity of fine, lively, or quick powder; this is said, from its mobility, to be *quick, or alive:* it is very inferior to the compact part.

MADDER-ROOTS.

Madder-Roots.—This article is another variety, assortment, or preparation of Madder; but the cause of the distinction between them, I am not acquainted with. The best article of this kind is the Turkish Madder-Roots.

Madder-Roots differ from common Madders in several respects; they are a much coarser and seed-like powder; are of a much higher color; of a stronger and more disagreeable taste, and they do not grow, or become of that crusty and adherent consistence that Madders do; the colors they give are of a stronger and more Orange cast;—it comes at lower prices, in comparison with Madders, so called. A good article, on being squeezed in the hand, sticks and adheres together, and shows the impression of the palm and fingers upon it.

It is used, in certain proportions, with Crop Madder, and with Munjeet in fast Reds, and for other purposes to which Madder is applicable.

I have used it in the Blue Vats to considerable advantage, though it is not comparable to the best Crop, for such a purpose; but I should prefer some of its best qualities before such Madders as we generally get in this country, for the use of the Vats.

I have never seen this article in the United States, although this does not show that there is none imported; but if there be any, it is of very rare occurrence: it would be an advantage to have it.

MUNJEET.

Munjeet.—This Dyestuff comes from the East Indies; but I know nothing of the plant of which it is a part—it is probably a species of Madder. It is imported in bundles of long, thin stems, which break of a red Orange color. It is ground into a very fine powder for the use of the Dyer, who confines it almost exclusively for producing Red, which is equally as durable, and far handsomer than Madder Red.

In dyeing with it, the operation is conducted in the same manner as Madder; but it stands boiling much better, for the color continues to brighten and get richer to the end of 15 or 20 minutes' boil, when it should be withdrawn; Madder is merely brought to the boil and then taken out.

It stands the solutions of Tin better than Madder or Madder-Roots, for it even requires a certain quantity of some solution of Tin, to give the color its utmost perfection.

It does not seem to possess two distinct species of coloring-matter, as Madder does, neither has it the same taste, and the color it affords is a more desirable Red, with less Orange tint to it.

Alum and Super-Tartrate of Potash are the proper Mordant, with a little solution of Tin in the Munjeet bath or liquor, in finishing; and the quantity of color it affords, is about the same as Madder.

The consumption of this article, in England, about thirty-three years ago, was amazingly great; all the Red Flannels for the American and other markets, were dyed with it, and all other descriptions of goods requiring a fast common Red. I have used, myself, for various purposes, an incredible quantity of it.

I have tried this article repeatedly, as a substitute for Madder, in the Woad Vat; but it never answered my expectation, although a respectable Dyer, (Mr. James Mills, of Rochdale,) whose veracity and information cannot be called in question, informed me that he used it regularly, in the place of Madder, and that it produced equally good effects. Experienced Dyers may try it, but on my own responsibility I do not recommend it for that purpose.

By combining the shades peculiar to each of these three articles employed for common fast Reds, Madder, Munjeet and Madder-Roots, we obtain a well saturated color, varying in its particular hue from those that are given by any of them simply.

The preparation is Alum and Super-Tartrate of Potash; the finishing with two parts Munjeet and one part of each of the other, and the addition of a little Nitro-Muriate of Tin at the end of the process.

One-eighth the weight of the whole, of Peachwood, or Hypernic, is an improvement.

N

NICARAGUA WOOD.

Nicaragua Wood.—See Hypernic Wood.

NUT-GALLS.

Nut-Galls.—These are not so much used as formerly, in Woolen-Dyeing, as they were employed more or less in Drabs, and as grounds for all the darker colors; but more especially for Blacks, in which they were considered an indispensable ingredient. Now they are rarely employed for anything, except some particular shades of Drab, &c.

The great consumption of Nut-Galls is in Silk and Cotton-Dyeing, in the operation called "galling," which swallows, of this substance, for some colors, from one-eighth to one-fourth the weight of the article to be Dyed.

In these departments of Dyeing, this operation is necessary, because these stuffs, not having a very powerful affinity, either for the coloring-principle or the metallic base of some colors, a medium of some kind or other, that has a strong affinity both for the fibre and color that is to be applied to it, is required.

Tannin, or the Astringent-principle, has a strong affinity for, and intimately combines with vegetable fibre, and also with color or its constituents, and therefore serves as the medium of combination; and as the greater part of Nut-Galls is this principle, we see the important part they play in the operations of Dyeing substances that have only a feeble affinity for colors.

But as Nut-Galls also contain Gallic Acid in considerable quantity, which is useless as an *intermedia*, one would suppose that a substance containing more Tannin and less Gallic Acid than Nut-Galls do, would answer this purpose better; and there is no doubt with me, but Catechu (which is one-half Tannin) would serve as the *intermedia* for some colors, as well as, or even better than Nut-Galls.

The properties of the Nut-Galls are more quickly and effectually extracted when they are finely ground.

Nut-Galls are excresences found upon oak trees, that have been caused by an insect perforating the wood, from which the juice has flowed and become concrete, in round balls. The best kind are the blue Aleppo-Galls.

The active principles in a decoction of Nut-Galls are Tannin and Gallic Acid, in the proportion of about 4 of the former to 1 of the latter; and the composition of this substance is as follows: 26 parts Tannin; Gallic Acid, 6.20 parts; Mucilage, 4.80; and the insoluble parts, 63 in 100 by weight,

The Gallic Acid is the coloring-principle of the Gall-Nuts, and gives a Black with solutions of Iron; it is obtained in a crystalized state, and is a representative of the coloring-principle in general. Its prime equivalent is 8.

The combining proportions of Nut-Galls and Sulphate of Iron are as 4 to 1; or 4 lbs. of Nut-Galls and 1 lb. of Sulphate of Iron.

Therefore, in Dyeing, and also in making Ink, 1 lb. of Copperas to 4 lbs. of Galls, will produce as good effects as though we had even as much Copperas as Galls.

O

OLD MADDER.

Old Madder.—Mull Madder, and any of the other qualities that have become brown and mouldy, and are spoiled by moisture and other causes, are denominated as Old Madder. It is used in Drabs, Olives, Browns, &c. See Madder.

P

PEACHWOOD.

Peachwood.—This article is used for common Reds, &c. See Hypernic Wood.

Q

QUERCITRON BARK.

Quercitron Bark.—This article is generally called Yellow Oak Bark, in America; but this is improper, as it is the Bark of the Black Oak (Quercus Nigra.) It is the inner bark, ground or bruised.

Quercitron is now very extensively employed in Woolen-Dyeing, for Yellows, Oranges, Auroras, &c.; for the abundance of its coloring-principle, and the cheapness of the article, as well as the expedition with which the Dyeing can be effected—all incline the Dyer to make use of it, in preference to Weld, Heath, &c., although it yields a color no way comparable to them, either in beauty or durability.

It is very rich in coloring-principle; and boiling water, or water at 190 degrees, extracts it in great quantity, and when this decoction is evaporated, it leaves a cinnamon, resinous looking substance, weighing 10 for every hundred parts of Bark originally employed: this is principally Tannin, Extractive Matter and Coloring-principle. One pound of Quercitron Bark contains as much Coloring-principle as 3 lbs. of Fustic, 6 lbs. of Heath, or 9 lbs. of Weld.

We obtain a much better Yellow, by precipitating the Tannin of the decoction with 1 lb. of Glue for every 15 lbs. of Bark.

For use, it is inclosed in bags and suspended in the dyeing liquor for half an hour, at a temperature below boiling, as the degree of heat necessary to ebullition is unfavorable to the brightness of this color, by the extraction of a greater quantity of Tannin, whose peculiar dun shade affects the beauty of the purer color given by the Coloring-principle.

The proper Mordant is Alum, Super-Tartrate of Potash and Murio-Sulphate of Tin; the whole Mordant about one-half the weight of the Quercitron bark employed, and this latter, for the fullest Yellow on Wool, to be about 2 lbs. for every 10.

The proportions of the two acids in the solution of Tin, must be made to vary, as we wish to get Yellows of a Lemon shade, or Yellows of an Orange shade;—for the orange hue, we must have the greatest proportion of Muriatic Acid; and for the lemon hue, we must have an equal quantity, or more, of Sulphuric Acid, or a Sulpho-Muriate of Tin.

For the very beautiful and delicate Yellows called Brimstone and Primrose Colors, I have most frequently used a Sulphate of Tin only, with about the same weight of Super-Tartrate of Potash, and very little or no Alum.

However, a general rule for determining the inclination of this coloring-matter, either to the Lemon or Orange cast of shade, will be, (supposing we are making use of the Murio-Sulphate of Tin, and we wish to diverge from a common Yellow,) to decrease the quantity of Alum and Tartar, (more particularly the Tartar,) and make up the deficiency with Muriate of Tin, and to boil briskly for the Orange cast;—and for the Lemon cast it will be, to increase the quantity of Alum and Tartar (more particularly the Tartar) and diminish the quantity of the solution of Tin, making up the deficiency, when a decided Lemon is wanted, by the addition of Sulphuric Acid, equal in volume to half the solution of Tin left out, and not to boil.

But the Lemon cast can be given, independent of this rule, by merely tinging the Dyeing bath with the least imaginable quantity of Sulphate of Indigo; and the Orange cast can be communicated either by a dust of Cochineal, or a small quantity of Pearlash; but it is better to give the particular hues, by a variation in the preparations or constituents of the Mordant.

Quercitron might be employed for Olives, Browns, &c., and as a ground for Blacks, in lieu of Shumac; as it gives different colors, with different Metallic Salts, were it not that it communicates a very harsh and disagreeable feeling to the texture of Wool or Woolen goods, and makes them work badly in the operations of manufacturing.

A decoction of Quercitron Bark, comports itself with Acids, Alkalies, Alum and the Metallic Salts, like a decoction of Fustic; the acids causing it to assume more of a Lemon shade; the Alkalies give it a fuller and more Orange look; and the different Salts employed as Mordants throwing down flocculent precipitates, more or less abundant, and of shades varying from pale Yellow to deep Olive, according as the radical of the Salt is more or less colored, and exists in a higher or lower state of oxydation. There is also some variation in the shade given by any particular Salt derivable from the peculiar Acid employed as the solution of the metal or earth of that Salt.

R

RED WOOD.

Red Wood.—See Hypernic Wood.

ROOTS.

Roots.—Madder is the principal article of this kind employed in Dyeing; but I think there are many kinds of Roots that might afford much coloring-matter, as Roots are in general more deeply colored than other parts of plants.

They have been but little examined, and I suppose their chymical constitution is not well ascertained.

S

SANDERS.

Sanders.—Red Sanders is the wood of a tree which grows on the coast of Coromandel, and elsewhere. It is of a harder and more resinous nature than Barwood or Camwood, which it greatly resembles, in other respects.

For use, this wood is well ground, and thrown loose into the kettle, where it requires more boiling than either Barwood or Camwood, or, in fact, any other Dyestuff, in order to extract its coloring properties. All substances that contain Tannin or the Astringent-principle, such as Shumac, Galls, &c., aid the water in extracting the coloring properties of this wood; Alcohol only will extract the whole of its color.

Without any mordant, it gives a dull orange Red color, which is very durable on Woolen goods. In Saddening upon this color, the different Metallic Salts, and Alum, produce colors of a similar character to Camwood and the same mordants; only, the Sanders colors are duller and less intense, which is owing to its coloring-matter inclining more to an Orange cast than either Camwood or Barwood.

Sanders contains more resin than either Barwood or Camwood, and gives a harsher feel to Wool dyed with it; but for some particular colors and purposes, it is preferable to them.

It is used for Browns, Plums, Corbeau, London Smoke, &c.; also for bodying Coarse Cloth previous to going into the Vat for Full Blue.

SHUMAC.

Shumac.—This is a shrub that grows naturally wild in the United States of America, at least as far north as latitude 45 degrees. It attains the height of 10 to 15 feet in this country, and perhaps more.

Although I have used some little of this wild Shumac, yet from the little acquaintance I have with it, I am not prepared at present to say whether, or not, it may be substituted for the Shumac of Commerce, in the processes of Dyeing.* I am inclined to think, however, that, by proper treatment, it might become a valuable auxiliary.

There are different species or varieties of this plant or shrub;—that from which the ground Shumac is obtained, grows in all the Islands and countries bordering the Mediterranean Sea, of which the Sicilian is reckoned the best.

In those countries, the Shumac shrub is cultivated for the purposes ot commerce, and the fresh shoots are cut down, yearly, to the ground, dried, and then ground in the manner it comes to us.

A boiling decoction of this powder has a fragrant and agreeable odor, not unlike good Tea; the color of it is a fawn Drab, which the Acids change more to a Yellow, and the Alkalies to a browner Orange hue.

Alum and solutions of Tin disturb the transparency of the liquor, and yield fawn-colored or brownish Yellow precipitates, and the liquor is clearer and more of a Yellow.

The cuprious Salts throw down Drab, and those with Iron for their base, give Lead-colored precipitates, verging on Black, when the metal is highly oxydized.

A strong decoction of Shumac gives nearly the same results as a weak decoction of Nut-Galls; consequently, the greatest difference between these two is in the respective quantities of Tannin and Gallic Acid which they contain; although Shumac does not afford as much Gallic Acid, in proportion to its Tannin, as Nut-Galls do; and, moreover, there is a Yellow coloring-principle in the former, that there is not in the latter.

These little differences vary the effects so, that although we may, in most instances, substitute a certain quantity of Shumac for a part of the Nut-Galls, yet in no case can it be supposed that Shumac, in any quantity, produces precisely the same results as Nut-Galls.

Ground Shumac contains one-sixth its weight of dry Tannin or Astringent principle, a small quantity of Gallic Acid, and considerable of a Yellow coloring-principle; and the combining proportions between it and Sulphate of Iron, are about 6 lbs. of Shumac to 1 lb. of Sulphate.

---

*It is used advantageously, at present, (1867) for some purposes.

The principal consumption of Shumac among Woolen Dyers, is as a ground work for Black; or, it is used with Logwood, in the Stuffing, for common Black. There is a prevaling opinion among Dyeers, that it has the effect of rendering the Black of Logwood more permanent; but I am inclined to view it in another light, more especially when Shumac is used with the Mordant, in the preparation; for I have always observed that a Black with a Shumac preparation, very quickly assumes a thin, bare mole color; or, as Dyeers generally express this appearance, it looks *mousey*. Very soon the entire color given by the Logwood disappears; which is to be accounted for by the action that an Astringent exercises upon the metallic base of the Color, or on the Coloring-principle itself, by robbing the Compound or Color of that quantity of Oxygen which was necessary to maintain it of a peculiar shade or hue.

I therefore assert that Tannin, or the Astringous principle, does not add to the permanence of any Color on Woolen goods, but that it has rather a contrary effect, and the only way in which it can be of service, is to add, by another shade, to the depth of some of the darker colors; but that the colors so made, are neither so beautiful nor permanent as they would have been, had the whole color been produced from a true Coloring-principle.

Shumac was couched and used as a substitute for Woad very extensively, I believe, in England, a few a years ago; but I understand it is now almost entirely laid aside. I sat a couple of Vats with it, which worked well, but I did not perceive any very great advantage that it possesses over the common Woad; nevertheless it serves to show, that in cases of necessity, we are not totally dependent upon the Woad plant, as a ferment, in producing the best Blues; and from this consideration, independent of the originality and singularity of the idea, the daring discoverer of this method of working a Woad Vat, is entitled to honor from the profession.

I am sorry that I am unaquainted with his name, for it deprives me of the pleasure of inserting it in this work.

The greatest consumption of Shumac is by Cotton and Silk Dyeers, as a "galling," or medium of combination between the stuffs to be colored, and the colors or their constituents; which combination is more easily effected and more permanently established by its intervention; because the superior affinity of the Tannin for these fabrics, modifies and softens its action upon the Coloring-principle, and on the Metallic Oxydes, so that it has not so powerful an effect in deoxydizing the colors upon Cotton or Silk, as it has upon the same colors when in union with it on Woolen goods, which holding it only by weak affinity, its properties have a chance to exercise their full energy upon the color, and so destroy it.

SULPHATE OF INDIGO.

CHYMIC, OR COMPOUND.

Sulphate of Indigo is not applicable, as a Color, to Wool that has to go through the process of Scouring and Fulling; but there is a great use made of it for coloring manufactured goods; Saxon Blue, Green, &c., &c.

The best proportions and method of making it for such purposes, are 1 lb. of good, dry-ground Indigo, and 4 lbs. of concentrated Sulphuric Acid (specific quantity 1.848)—into a well glazed earthen, or lead vessel; first pour one-half the Sulphuric Acid, then gradually (stirring it all the time) run in the ground Indigo; work these well together, until you perceive the Indigo to be all moistened by the Acid, then give it the remainder of the Acid and incorporate the whole well together by stirring the mixture for 15 or 20 minutes;—stir again, at intervals, during the day, and let it be 24 or 36 hours old, before using it.

As this combination takes place, the compound assumes a frothy appearance, increases in volume, and much heat is generated, with the disengagement of a suffocating gas;—these phenomena are the certain accompaniments of the progress of the combination; and when they have all ceased, the chymical union is completed.

Sometimes, either from the low temperature of the atmosphere, or other causes, the fermentation, or rather chymical action, does not readily take place;—in this case, some Dyers throw in a little powdered chalk or pearlash, with a view of exciting the necessary action of the two constituents of the compound; but this is only a poor way of doing the business, for it merely creates (by the disengagement of the Carbonic Acid of the chalk or pearlash) motion among the particles of Indigo and Sulphuric Acid, without in the least promoting the chymical action whereby the combination only can be effected. The better way is to heat the mixture, by immersing the vessel containing it in hot water, when a reciprocal and true action takes place, on the principle that some combinations are made at one temperature that could not be effected at another.

I think the addition of chalk or pearlash rather injurious than otherwise, as a Sulphate of Lime or Potash is immediately formed, which (so far as it goes) has a tendency to render a portion of the Sulphate of Indigo insoluble in the Dyeing liquor.

When this solution is properly made, so intimate is its union, and so great its divisibility, or capacity of attenuation, that it takes 500,000 times its weight of water to render the smallest drop of it imperceptible: it would, therefore, be no very expensive affair to convert any of the great American Lakes into a Dye-kettle; nor be beyond the power of man to tinge the mighty waters of the Ocean, did not the azure of its fathomless depths, mock, by its clearness, any vain attempt of his.

This very soluble color works easily and evenly upon Woolen goods, with a Mordant of Alum and Argol for Green, and a quantity of Super-Tartrate of Potash for Saxon Blues. Some good Dyers use, also, Alum for the Saxon Blues, but I never could ascertain what part it played in the operation of Dyeing with Sulphate of Indigo, or when the employment of it was in any way necessary or beneficial. I am inclined to think it is prejudicial to the beauty of the color; but the Dyer must bear in mind that I do not wish to confine him to any particular recipe of mine, to the exclusion of all others, much less to assign bounds that he shall not overstep, or limits that he shall not pass, in the onward march of improvement. I wish him not to take either myself or any other man, as an infallible guide, further than we are guided by the light of Nature; but rather that he should study the natural constituents and combinations of Color, and take Nature as his model, and when she says, thus shalt thou do; or so far shalt thou go, and no farther; thus do, and there stop.

The Sulphate of Indigo gives only a fleeting color, and no Mordants or any methods ever adopted, can increase its durability; for the action of Sulphuric Acid upon Indigo is so powerful, and the combination between them so effectual, that the resulting compound no longer remains Indigo and Sulphuric Acid, separable by the saturation of the Sulphuric Acid by an Alkali, but a new substance, which forms a triple union with Alkali, from which the Indigo, as Indigo, can never be recovered, or even made to produce the effects of Indigo, in any kind of a Blue Vat.

In Dyeing Saxon Blue, with the Sulphate of Indigo, care must be taken not to boil it too much, as by a long ebullition the shade becomes dull and greenish.

T

TANNIN.

Tannin.—I have described this as the Astringent-Principle, (which see,) although it generally exists in vegetables called Astringent, as Galls, Shumac, &c., in conjunction with other immediate materials, such as Mucilage, Extractive Matter, Gallic Acid and Coloring-principle.

Tannin, when pure and divested of all the last named matters, is a brown, resinous looking substance, which dissolves easily in boiling water, and is separable from it by Gelatine, Carbonate of Potash, and Hyper-Oxy-Muriate of Tin.

Although it exists more or less in almost all the common Dyestuffs, yet it is a distinct principle from that which is the immediate cause of Color, in the operations of Dyeing, and to which I have given the name of Coloring-principle; nevertheless, I am of the opinion that Tannin is the radical of the Coloring-principle; or at least, that the former, either by absorbing more Oxygen, or from a change in the quantity of its Carbon, or a new arrangement of its constituents, or by a combination of all these causes, passes into, or becomes the Coloring principle: however, as there is no positive proof of such a connection, we will view them as two distinct substances, and point out the peculiar features that distinguish one from the other.

Tannin, when separated from every other substance, and in a pure and dry state, is uncrystalizable, and appears as a brown colored, brittle and resinous looking matter.

Coloring-principle, when separated from every other body, is, in general, a mass of crystals, and possesses the property of precipitating all the Metallic Oxydes from their solutions, (of producing well defined colors,) which Tannin does not.

The two principles may be separated from each other, when in solution, by the addition of Gelatine, which precipitates the Tannin, but leaves the Coloring-principle in solution.

Tannin abounds more or less in almost all vegetable substances and Dyestuffs; Logwood, Fustic, &c., contain considerable of it;

Catechu 50 per cent. of it; Nut Galls, 26; Shumac, 17; Quercitron, 6; or very nearly the above proportions, as a general result.

According to the analysis of Tannate of Lead, by Berzelius, the prime equivalent of Tannin will be 26,923; and its constituent principles 4.186 of Hydrogen; 51.160 of Carbon; 44.654 of Oxygen=100.

Tannate of Lead is composed of 100 Tannin and 52 Oxyde of Lead, and the prime equivalent of Tannate of Lead is 40.923.

V

VALONEY.

Valoney.—This article is used as a substitute for, or in the place of, Nut Galls, Shumac, &c., and possesses properties and produces effects nearly allied to these substances.

It resembles the cups of acorns of the oak, only larger in size, and I believe is principally used by hatters; but being practically unacquainted with it, or at least having used but little of it, I am not prepared to say anything further respecting it.

W

WELD.

Weld, or Woald.—This plant is a native of the southern counties of England: but it is cultivated there, and also in France, Germany and other European states, for the use of the Dyer; also, in the United States of America. It grows to the height of two or even three feet, in straight stalks or stems, about the thickness of a pipe stem; but the smaller these are the better the article is supposed to be.

It gives one of the most beautiful as well as the most durable Yellows we are acquainted with, on Woolen goods: but it requires a great quantity of the plant to produce a deep shade, demanding, for a full Yellow, an equal, or even greater weight of the plant than there is of the Wool or Cloth.

The usual way of Dyeing with it, is either to enclose it in a bag, or throw it loose or in bundles, into the kettle, and then sink it under the liqor by a weighted wooden frame: after boiling a couple of hours, it is withdrawn, and the Wool or Cloth (previously prepared) is entered and Dyed as usual. A bucket or two of Urine, or some Pearlash, is used with the Weld.

The preparation or Mordant is Alum and Super-Tartrate of Potash, in the proportion of 8 of Alum and 1 of Tartar, to 16 of Wool: the boiling, two hours.

The color it gives with this Mordant always inclines to the Lemon shade, and is of such softness, purity and unmixedness of hue, that no other Dyeing material can equal it. Its permanence, also, is incomparably greater than any other Yellow on Woolen goods. These superior qualities still preserve it in use, notwithstanding the lower price, more abundant coloring-matter, or easier modes of applying some other Yellow Dyestuffs, cause them to be substituted for it, whenever practicable.

The solutions of Tin can be used in the Mordant for Weld Yellow upon Wool, Yarn, or Flannels: but for Fulled Cloth, it is objectionable, because the solutions of Tin give a precipitate or color that does not enter the body of the Cloth so well; or, in other words, does not *ground* it so well as when Alum and Tartar alone are used.

On the whole, I see no great advantage to be derived from using the solution of Tin as a base for the Weld color, on any description of Woolen goods; the most natural or appropriate Mordant seems to be Alum and Tartar.

As Weld is only used in such colors as require a very bright and permanent Yellow, such as Woaded Greens, &c. &c., and as the Mordant for this is the same as for Yellow, it will be of no use here to describe the phenomena presented by other Metallic Salts, &c., upon this Dyestuff.

Weld ought to be stored in a dry place, and kept free from dirt, or the intermixture of other Dye-wares.

WOAD.

Woad.—As this material is of so much consequence in the important business of Blue Dyeing, and forms the basis of the composition of the Woad-vat, and as the regulation of its fermentation constitutes the knowledge of the Woad-man, and the lack of which is the cause of all those difficulties and disasters that sometimes occur in conducting this most delicate and inexplicable process of Dyeing, it will be necessary that we should be very particular and correct in our description of the manufacture, qualities, and mode of operation of a substance on which so much depends.

The expensive materials and complicated nature of Woad-vats: the little we know of this species of fermentation: the practical experience and the great skill required in the Dyer, successfully to conduct them, all demand that whatever ideas he may imbibe relating thereto, ought to be true ones, and founded upon a knowledge of these Chymical changes incident to them, which take place only in virtue of the power of certain Laws that govern the action of one species of matter upon another species; apportions their combining quantities; and stamps a character upon the product.

A knowledge of these Laws or Attractions will convince him that the aspects presented by the Woad-vat, are not the productions of mere chance, but the effects of determinate and well regulated action, and it only requires to understand the affinities that cause, to comprehend the change that will result from, their operations; and these being once known, will dispel all the uncertainty, and reveal all the mysteries connected with the management of this invaluable branch of the Art of Dyeing.

Knowing then, the need and the importance of diffusing no other than correct information relative to so important an article as Woad, I shall be careful in what I say about this comparatively unknown subject, to base my observations on the facts revealed by experience and in accordance with the principles that regulate the operations of the Woad-vat; leaving the full development of its causes and effects to future investigations, either by myself or others who may have greater facilities and qualifications for such an undertaking.

The Plant (Isatis Glastum or Isatis Tinctoria) which, when made into a fermented paste or dryed balls, are in this state called Woad, is a native plant of England, and has been used as a coloring material (either to Stain the bodies of the savage Britons, or to Dye the garments of their more civilized descendants) for two thousand years: and the accumulated experience of ages, transmitted from father to son, hath given to the artizans of that country a mass of practical information regarding its manufacture and mode of operation as those of no other nation possess; and the English Woad Dyers, in consequence of this long continued experience, are the safest and best workmen in the world, as the decided preference given to their Woaded Blues in every market on the globe, bears overwhelming testimony.

The Woad Plant is cultivated in the United States, in Great Britain, in France, Germany, and other European States, for the use of the Dyer, and when the cultivator judges it to be sufficiently matured, it is cut and then ground into a sort of pasty mass, which is piled in a heap, when, after a time, heat is generated, and fermentation commences, with the disengagement of ammoniacal gas; during the progress of this process, the heap is turned or worked over, sprinkled with water or with Lime, as the operator thinks best, in order to regulate the temperature and accelerate the fermentation, or retard its too rapid operation; this treatment is continued for two or three weeks, according to the state of the weather and other circumstances, and the process is termed Couching.

This is the Paste, Couched, or Cask Woad; and differs from the Ball or Balled Woad, inasmuch as the latter is merely the ground plant made up into balls and then dryed under an open shed, without having undergone the process of Couching, as described in the manufacture of the Cask, or Paste Woad.

Previous to using this balled Woad in the Vat, it must be reduced to powder, moistened and piled in a heap, and submitted to fermentation, or undergo the process of Couching, in the same manner as the Paste-Woad.

The Process of Couching is the act whereby the separate and dissimilar parts of the Plant are converted into a coherent and homogenous substance, possessing very active powers; and as the operation of this material (now become Woad) is the cause to which we must look for all the phenomena presented by the Woad-Vat, it may not be amiss for us to inquire into the nature of the change that has taken place, or to endeavor to ascertain in what state the article exists.

When the recently ground plant is piled together in a heap, and the process of Couching has commenced, the operation that is going on is precisely the same as that which takes place in a dung-hill, when that is suffered to ferment.

Chymists distinguish only three different species of fermentation —the Vinous, or that which converts saccharine matter into Alcohol and Carbonic Acid; the Acetic, or that which converts Sugar or Alcohol into Acetic Acid or Vinegar; and the Putrefactive, or that which separates organic bodies into earthy matters, (which remain,) and into fœtid and inflammable gases, which fly off.

It is for us to determine whether the Process of Couching (and the proper fermentation of dung) belongs to any of the above species, or whether it does not rather constitute a fourth species or stage of Chymical action, unexamined and undefined by any of the Chymical writers, who have described the phenomena of Fermentation.

That it is not the Vinous action, is quite clear, for no Alcohol is formed, nor any Carbonic Acid given off: that it is not the Acetic, is positive, for there is no production of Vinegar, or any other Acid: that it is not the Putrefactive process, is certain, for it neither evolves a fœtid, nor an inflammable gas, nor leaves an inert, earthy residuum; but, on the contrary, it exhales a fragrant, exhilarating, unflammable Ammoniacal vapor, and the remaining substance is remarkable for its energy.

These facts are indubitable evidence that it differs entirely from, and belongs not to, any of the above species of fermentation: that its products are not similar, nor the substance like unto any of the three; and seeing that it is fermentation, it must, of necessity, constitute a fourth species, whose characters are as well defined, and whose features are as distinctly marked, as any of the preceding; and it devolves upon me to show what these are, in order to assign it a location and give it a name, in the scale of Fermentation.

When the Couching Process is proceeding in a regular manner, a great quantity of Ammoniacal gas is evolved from the fermenting mass, and all the tendencies of the process are to the production of Alkaline properties; and this continues until the process ceases, when the remaining substance (now Woad, still exhaling Ammonia) retains very energetic qualities, which continually produce fresh Alkali. Therefore, I define these energies, from the nature of their products, the Alkaline state of Fermentation.

Such, then, is the nature of the Process of Couching, (and also of the proper fermentation of dung,) for the products and energies at work, in both cases, are identical. As we shall show in the sequel, that the Alcoholic and Acetic kinds of fermentations, both pass into the Alkaline species, before running to putrefaction, this circumstance marks out the position which the Alkaline process occupies, as the one immediately preceding the Putrefactive state, or that particular act which completes the entire destruction of the matter subjected to fermentation.

And as the Alkaline process approaches so near to the Putrefactive, (there being but a step between it and destruction,) this shows the great skill and care that is required in the workman, to prevent such a catastrophe. Hence, the difficulty experienced in the management of Woad Vats is not to be wondered at.

We will now describe the marketable qualities of the Article Woad, to enable the Dyer to make a judicious choice of such specimens as are good and safe to work. There are three general appearances of Cask-Woad, only, that I shall notice: the Brown or Foxy; the Dark Colored and Muddy formed Woad; and the Fine Olive-Green Colored and fragrant smelling Woad.

The best Woad is of a Green-Olive Color, interspersed with parts of a browner appearance. It is rather tough and adherent than otherwise: when a piece of it is gently opened, it strings out into fine, silky filaments or fibres, which possess considerable tenacity; it has an agreeable and sweetish ammoniacal odor; when mixed with water it does not dissolve very readily or fall asunder, but has a doughy toughness, and requires considerable working to convert it into a light, pulpy substance. When so dissolved, its soluble portion imparts to water a deep Brown color, inclining to Olive, and the liquor has considerable substance or body.

These are the distinguishing characteristics of a good Woad, and show that the Couching has been properly conducted.

The Brown or Foxy Woad differs in appearance from the preceding description, chiefly in color, which is redder, or more decidedly Brown; also, it has a stronger and less agreeable odor; in other respects, it answers the description of the greener or more olive kind, if the article be good.

A first rate Foxy or Brown Woad is much stronger than the one I have described as the best; but it is a very dangerous article to work, for it comes on, or springs, in such a rapid manner, that a great deal more watchfulness and skill are required in bringing it to work than any other kind; and moreover, as it bears a great quantity of Ware, and as its fermenting powers are so strong, it frequently takes plunges of violent fermentation that require considerable tact to manage; therefore, this kind is very unsafe in the hands of an inexperienced workman. But when once fairly brought under subjection, it will execute better work than the other sort, and on this account, for my own use, I prefer it.

The great cause of the impetuosity of this Woad is owing to its not having been sufficiently fermented in the process of Couching, and its red color may probably arise from the plant having been too much matured before it was gathered; or possibly from other circumstances and causes that I am not acquainted with.

I have now to caution you against the worst and utterly worthless kind of Woad, of which we too often find specimens in th market; I refer to a heavy, lifeless, dark mud-like article, whose circulation among the Dye-houses is known, by us hearing of difficulties experienced in working the Woad Vats, all through the country: or at least at all those places to which this spurious article has found its way.

This substance, in the state of paste, is very mobile, having little or no adherence in its parts, nor possessing any tenacity; it will not hold together in the least, but breaks off without any filamentary or fibrous appearance; it is short and earthy, and its odor is similar to that of dock mud, from which it can scarcely be distinguished by a superficial observation.

On being thrown into the hot water in the Vat, it readily falls asunder, and needs little or no working with the rakes; the appearance of the liquor formed by it is grey-colored, wavy, glistening or shining, as though it was greasy; in fact, it looks for all the world like strong, dirty, soap-water, that has been used for washing colored clothes.

The smell of this liquor is vapid, and very much unlike the fragrant and exhilarating odor of a newly set Vat.

The mode of its operation is fitful; sometimes it springs itself quickly, at other times it comes reluctantly to work; but what distinguishes it greatly, is, that after working feebly a certain, but short time, it suddenly, and without any assignable cause, ceases to operate: the Indigo precipitates, the liquor is thin, odorless and flat, and no common means have the least effect by way of imparting energy to the death-like stupor of the materials.

This is a true case of suspended animation, which has supervened, not through the unskillfulness or negligence of the Dyer, but from the sheer exhaustion of the little fermenting power that the Woad possessed; and the best, or the worst Dyer in the world, must stand acquitted under such circumstances; for it occurs when the Vat is fairly balanced, as regards Ware, and there has been no disengagement of noxious effluvia, indicating that it had run into the Putrefactive state, or (as Dyers term such a catastrophe) run away; in fact, it is almost impossible for this sort of Woad to exhibit such signs, for the greater part of it has already passed through that state before it came to the hands of the Dyer, and of course could not, a second time, undergo the like destruction. I shall presently show this to have been the case.

We have shown that the Indigo is still there, but that there is not energy enough in the Woad to deoxydize and bring it into solution. This must come out—what's to be done? Well, we have shown that we cannot do anything by the Alkaline fermentation of the Woad, for that is at an end. We are, therefore, under the necessity of having recourse to another species of fermentation, or to some substance having such affinity for Oxygen as to take it from the Indigo, and cause that to dissolve in the Alkaline menstruum of the Vat.

If we wish to do it by fermentation, (which is the most proper method,) we take substances containing much saccharine matter, and bring on the Alcoholic process, which deoxydizes the Indigo, and by employing Alkali we dissolve it.

Or we can effect the same purpose by Sulphuret of Arsenic (Orpiment) and Alkali, if there be any needed. Or even by the use of Astringent matters, such as Shumac, and suffering these to Couch in the Vat, and then proceeding us usual, the same object is effected.

All these plans are successful, in the hands of a skillful workman, for getting out the Indigo in such cases, and then the contents are to be thrown away.

The cause of the bad effects of this Woad, is, that in the process of Couching, it has suffered too great a degree of heat, and the major part of it had passed into the Putrefactive state, and very little fermenting power remained in that which was uncontaminated by it.

The Dyer will therefore be cautious not to purchase or use such an article, for it may be attended with very serious loss.

Various substances have, at different times, been tried as substitutes for the Woad Plant, or for Woad, so called: the most successful have been the germs or sprouts of barley, obtained from the malting kilns, and called Malt-comes; also, Shumac. (This latter of recent introduction.)

The best Woad I ever used in my life, I made from the wild Indigo plant of the United States, and have no doubt but the cultivation of that plant for this purpose, would be an acquisition, as it contains a certain quantity of Indigo.

The good or bad qualities of Woad, depend not so much upon the country that produces it, as upon the care and skill bestowed upon its manufacture. And the difference, both in the mode of operation, and in the price of English and American Woad, is entirely owing to the latter circumstance, for I can speak from long acquaintance with the two, that the quality of strength is decidedly in favor of the American plant.

Notwithstanding this advantage, the English Woad brings twice as much money, even in the American market: no very favorable specimen this, of the boasted superiority of American skill and ingenuity. This inferiority is not to be attributed to the quality of the plant, or from the reason that no information can be obtained of the proper method of manufacturing the Woad; but from an inordinate love of gain, and a desire to become suddenly rich, which makes them forget that the value of an article is in proportion to the time and talent expended upon its manufacture, and that a regardlessness of the character of the article, by slighting its manufacture, is the surest way to condemn it with the public, and ensure its final expulsion from the market.

We will now turn to the consideration of that operation of Woad, which constitutes it so consequential an article in the composition of the Blue Vat, viz.: the Fermentation of Woad in the Blue Vat.

But before I proceed to investigate this most important and least known of all the processes of Woolen Dyeing, it will be necessary to give a slight outline of Fermentation in general; of which genus the operation of working a Woad Vat is a species. This description seems requisite to enable the operator to understand the nature of the intestine action going on among the different materials of the Vat.

ON FERMENTATION IN GENERAL; AND ITS CAUSE.

Fermentation is a spontaneous effort of the ultimate constituents of matter to change their state and enter into fresh combinations or forms; and this action is independent of, and distinct from, those simple affinities that dispose Acids and Alkalies to unite so as to form salts, and does not depend upon antagonist principles mutually exerting their forces upon each other, giving birth to inert compounds, possessing no particular properties; but it is in the abstract a true combustion, though silently and invisibly performed; it is Nature's method of Analysis, whereby compound and heterogeneous bodies are decomposed and resolved into simpler forms of matter: a process that attenuates and disperses substances, causing the solid to become liquid, or the liquid to assume the gaseous state; it is that operation which performs, in the same order, but in a slower manner, all the agencies of Fire; first driving off the most volatile parts, next attacking the liquids, and converting them into gases, it disperses those in like manner; and finally, the more solid parts undergoing a similar metamorphosis, are ultimately dissipated, until nothing is left but the incombustible and untractable earths or metallic oxydes. Therefore all the tendencies of the Process Fermentation, from its commencement in the Alcoholic stage, to its final cessation in the Putrefactive, are to what we call destruction, or (more correctly speaking) to the entire separation and dispersion of the combustible constituents of the matters subjected to its action: and so progressive and effectual is this dissolution, that no calorific influence, however powerful, could have accomplished it more certainly; for it does, when suffered to pass through its different stages, produce exactly the same results as Destructive Distillation.

Wherefore, reasoning from a similarity of results, in the two cases, I conclude that the passage of what we designate as caloric, or heat, into the body of the materials subjected to fermentation, is the cause of the effects we perceive, arising from that process; and although the sensible heat of the fermenting body may not, in many instances, exceed the temperature of the human frame, yet this is no proof that as great a quantity or degree of heat has not passed through the fermenting mass to effect its complete decomposition, as would have done had it been exposed to the direct action of fire, in a retort, by the process of destructive distillation;—because the fermenting mass, obtaining its caloric only by its own intestine motion and from an internal source—and this being carried off as fast as it is generated by the quantity of vapors or gases to which it has given elasticity—is kept comparatively cool; while the matter subjected to destructive distillation, being supplied with its caloric from an external source, and as it continually receives fresh increments of heat in greater quantity than can be carried off by the ejected gases, it possesses, in consequence, an elevated temperature.

But I maintain that no more heat or caloric has been taken up by the matter exposed to destructive distillation, in order to dissipate its constituents, than there has been required to disperse in like manner, the gaseous products of common fermentation; for it requires only a certain quantity of heat to maintain matter in a certain state, (whether solid, liquid, or æriform) and when that specific quantity has passed into it, it admits of no further addition;—in other words, the capacity of bodies for Heat is limited by the nature of their constitution.

If, then, so great a quantity of Caloric has been required to change the form of the fermenting matter, and if it has received none from any external source, the question naturally suggests itself, whence came this heat? or, how did it originate?

In answering this inquiry, I shall proceed on the data, that the Universal presence of Electricity, or the Galvanoid Fluid, is the all-pervading, all-surrounding force, quality, or power, that penetrates and envelopes every particle of matter, however, or wherever situated in the Universe of God;—is an atmosphere or medium extending through and beyond all Systems and Worlds, possessing an Omnipresence of existence, in which all material Nature is immersed;—it is that principle for which the several elements of matter, having different capacities, assume, by the force of its power, different volumes, and by it retain their separate existences;—it is that imponderable cause which shines in the Light, warms in the Heat, and lives as the life of all things;—it is the great power of God, whereby every change and all motion takes place, from the silent action of fermentation, to the terrible convulsions of a volcano, and from the imperceptible vibrations of an atom to the revolution of a world upon its axis, or the wheeling of a comet through the immensity of space.

To this inexhaustible source of effects, we are to look for the Cause of Fermentation, by understanding that the action of this principle upon the several elements of Nature, in causing them to assume different forms, shapes or combinations, is sufficient to account for all the phenomena presented by that process.

The presence of Electricity every where;—the various capacities or attractions of bodies for it, and its continual tendency to an equal distribution of its power, or an inclination to find a level or equilibrium, makes it the ever-active and all-controlling agent in the operations of Nature.

That this imponderable element exists in all bodies, and that its greater or less quantity in any particular body, determines the existence of that body as a solid, a liquid, or a gas; and that the sensation which we call heat, and to which it is customary to attribute these effects, is nothing more than a result, or mere sensation, whereby we perceive or experience the passage of this element from one substance to another, as it resumes that equilibrium, which had been disturbed by the unequal affinity of the different species of matter for it; and as this passage is more or less rapid, or in greater or smaller quantity; so is the degree of Heat, or sensation excited, more or less acute or intense; until finally, when this change is effected in large quantities, and with great velocity, Light is evolved, or the property of Shining is communicated to bodies through which this energy is passing.

Therefore, Heat and Light have no existence, independent of Electrical (or Galvanic) changes; and they are not matter in any of its species or forms; but simply sensible perceptions, or visible manifestations to us of changes taking place in matter, by the operation of an energetic power;—they are only effects of a prior and greater Cause—simple results flowing from velocity of motion—mere sensations of vibrations amongst ultimate particles.

And although both Light and Heat can, and do exist, separately, distinctly and independently of each other, and one is perceived when the other is not present; yet can this seeming anomaly of the violent passage of the Electrical power, producing simultaneously both these phenomena, be reconciled, on the idea of the peculiar nature of some bodies to throw off both, and other bodies only to exhibit one of these sensations?

All the effects which are attributed to Light and Heat could be accounted for on this Theory, were this article a dissertation on the phenomena of Heat and Light, instead of being an inquiry into the Cause of Fermentation; still the nature of the inquiry has unavoidably led to observations respecting them, which, though apparently irrelevant to the subject, were yet necessary to illustrate it more clearly, and enable me to draw the line of distinction between Cause and Effect.

I shall now confine myself to a consideration of Electricity, in connection with Fermentation.

Seeing, then, that an atmosphere of Electricity surrounds the heterogeneous mass, when first put together for fermentation, and that its equilibrium is continually disturbed by the changes going on through all nature, it is evident that a discordant mixture (of different principles) cannot long remain at rest, but that spontaneous changes will take place, in consequence of the dissimilar capacities of the several substances (of the mixture) for Electricity.

This change or motion gives rise to the sensation Heat; the temperature of the mass rises, and the Electric power, or fluid, (or whatever else we term it,) combining to saturation with its most susceptible parts, carries them off in volatile products; and as the fermenting substance is continually drawing off the Electricity from external Nature, with which it is in contact, and as every moment renders the mass more and more dissimilar in its composition or capacity for this power, the rapidity of the motion becomes more and more energetic, until, as it passes with increasing velocity through its different stages, the action becomes (in some cases) so violent and intense as to set Fire to the mass.

Hence, the greater difficulty of stopping or retaining the fermentation, at any desired point, increases with the progress of the operation.

In tenor with the foregoing observation, I consider Electricity as the ulterior or exciting Cause to which all the Phenomena of Fermentation are plainly referable; as are all the other changes in Nature.

This, then, is my definition of Fermentation and its Cause, and I shall next proceed to describe its several species, or the different stages of its progress.

THE DIFFERENT SPECIES OF FERMENTATION; THEIR PRODUCTS, AND MODE OF OPERATION.

We have shown the exciting cause of Fermentation to be Electricity; we have seen, too, that the whole tendency of the process, from its commencement to its close, was to decompose and dissipate the constituents of the substance exposed to the operation; that in this process towards destruction, it gives rise to different products, which, by the distinctness of their characters, serve as *criteria* of the several stages of the process, and point out how far the operation has advanced towards its final accomplishment.

These steps, or stages, are denominated species of Fermentation; but none of them can take place in an incombustible body (for fermentation being an actual, though invisible combustion;) its phenomena can only be exhibited among combustible materials, or in such bodies as have the power of taking the gaseous state.

These states, or kinds of Fermentation, have been termed, (in this Article,) from their distinguishiug characteristics, the Alcoholic; the Acid; the Alkaline; and the Putrefactive states of Fermentation;—and as all vegetable matters are composed chiefly of Carbon, Oxygen and Hydrogen, with occasionally (as in such as are of an Albuminous character,) Azote, interspersed sometimes (as in Woad, &c.) with foreign mineral substances; this knowledge of the constitution of matters undergoing fermentation, and the chymical properties of their products, will enable us to comprehend what particular principles remain in the fermenting mass, at each and every stage of its progress, and what kind have been separated from it;—it also explains the reason why, in some cases, the fermentation should commence with the first, and run successively through all the succeeding stages, to the final dispersion of all the combustible constituents; or why it should, in other cases, commence at the second, third, or even the last stage, without having passed through the preceding ones.

As the changes produced by fermentation can only be fresh arrangements of the above-named few principles, the proportions in which these exist in the mass will determine what state of fermentation shall first commence, (though this is liable to some modification from the state of the atmosphere, and other circumstances.)

1st. For instance; when the constituents are in the proportions of 4 Carbon; 3 Oxygen; 2 Hydrogen; and 1 Azote, fermentation begins in the Alcoholic state.

2d. When the Oxygen is in excess over the Carbon, or when the proportions are, 4 Oxygen; 3 Carbon; 2 Hydrogen; 1 Azote, then Alcohol cannot be formed, because the excess of Oxygen acidifies the product, and gives rise to the Acetic fermentation.

3d. When the fermenting body contains little Carbon or Oxygen, compared with its Hydrogen or Azote; as, suppose the proportions to be reversed, and we have 4 Hydrogen; 3 Azote; 2 Carbon; and 1 Oxygen; here the greatest proportion of the constituents being such as compose Ammonia, the Alkaline fermentation must, of necessity, commence first.

4th. And when the proportions stand, 4 Azote; 3 Hydrogen; 2 Oxygen; and 1 Carbon, it is plain that the preponderating principles are all of an elastic character, and the least quantity of Electricity (or Heat) serves to dissipate them in noxious vapors, characteristic of Putrefaction.

Thus, when the constituents of the compound are put together, in the first-named proportions, the effect of the fermentation is to separate, or carry off a portion of the Carbon and Oxygen, as Carbonic Acid, which leaves the remainder in the proportions that form Alcohol; but as Alchol does not contain as much Oxygen as Acetic Acid, it is evident that a reaction is necessary, or an absorption of Oxygen must take place by the Alcohol, before that can be converted into acid, or exhibit the Acetic Fermentation. Hence, the propriety of uncovering Wine and Cider casks, in making Vinegar. Acetic Acid is little else than oxydized Alcohol.

And, in the third case, the effect of the Alkaline fermentation is to carry off another portion of the Carbon and Oxygen (which are constituents in both Alcohol and Acetic Acid,) leaving the Hydrogen and the Azote to enter into combination as Ammonia.

And, lastly, on the evaporation of the Ammonia, the remaining Azote, Hydrogen, Oxygen, and Carbon, (being a surplus of the constituents more than was necessary to form all the products of the other three species of fermentation,) now form compounds with the phosphorus and Sulphur, (if any be present in the fermenting article,) and give rise to phosphoretted, Sulphuretted, and Carburetted Hydrogen, and other nauseous and inflammable gases, that characterize the Putrefactive process; which completes the separation of all combustible materials from the subject of fermentation;—the operation is at an end, and the disorganization of the substance is completed.

We have seen that the Alcoholic, Acid, Alkaline, and Putrefactive kinds of Fermentation, under certain circumstances, run, in succession, from the first to the last stage, every stage being distinctly separated, and known from the other, by phenomena peculiar to it.

And although all fermentation tends towards, and ultimately ends in the Putrefactive process, yet any of the stages of this operation can, by proper management, be made to remain *in situ*, and be preserved in that state which distinguishes it as a separate species, and its further progress arrested.

But it does not follow that in order to produce any particular species of fermentation, we should go through the other stages that precede it; for although they are in some measure connected together, still they are each independent of the other; insomuch as the proportions of simple principles in the mass must be various, to give rise to the different kinds of fermentation; and the Putrefactive state can commence at once, without necessarily passing through any of the others; the Alkaline can also begin without the least indication of their ever having been either Acetic or Alcoholic fermentation;—and the Acid or Acetic process can start without any previous formation of Alcohol.

So if we begin with the Alcholic fermentation, we can then carry the operation to its finis, through the Acetic, Alkaline and Putrefactive stages;—if we commence with the Acetic, we can pass through the Alkaline and the Putrefactive processes; and by beginning with the Alkaline, we can continue it through the Putrefactive. But if the Putrid fermentation commences first, none of the other stages can be elicited, for destruction has commenced at once, and all the combustible materials of the mass are separated, one from another, and the whole totally dissipated.

Thus, when fermentation has arrived at any certain stage, it may progress towards its final consummation; but cannot retrograde in its action;—therefore, the Alkaline state may pass forward into the Putrefactive, but not back into the Acetic or Alcoholic stages; and the Acetic may go through the Alkaline and Putrefactive processes but can never be brought back again to the Alcoholic species;—so the tendencies of every species of fermentation urge it onward, until all substances composing its subject have been driven off, and nothing remains except matters incapable of taking the aeriform state.

This general description of Fermentation, its different species or stages, and its mode of operation, have been given under the impression that it would be serviceable, in enabling us to comprehend more clearly what we are now going to observe, respecting the Alkaline Species of Fermentation—or the operation of Woad in the Blue Vat.

THE ALKALINE SPECIES OF FERMENTATION; OR THE OPERATION OF WOAD IN THE BLUE VAT.

We have shown, in describing the Couching or Curing of Woad, that it was brought by that process into such a state as to have a continual tendency to the production of Ammonia; or into a substance whose fermentation commences in the Alkaline stage.

The soluble substances present in Woad are chiefly Mucilagenous and Extractive matter, Albumen and a little saccharine matter; the Albumen furnishes (independent of absorption from the atmosphere) the Azote necessary to the formation of the Ammonia, which it creates and evolves during its fermentation.

The Woad Vat is put together at a temperature of 170 degrees, and the ingredients that enter into its composition are Woad, Madder, Bran, Lime, and Indigo: when in the course of ten or fourteen hours, chemical action is perceived to be going on by a change in the appearance of the composition, which shows that the operation of the ingredients has commenced.

It is to ascertain what part each of the above articles perform, and what is the nature of the operation, that we have now to consider.

In the first place, the solution of the Indigo is the object we have in view, when we put the Vat together; therefore, that substance is the one to be operated upon by the other ingredients of the composition; and we have shown, in a former part of this work, that in order to effect this solution, the Indigo had first to be brought into a lower state of oxydation, and then an Alkali must be present before it would dissolve in water.

2d. This fact will convince us that the most important functions of the Vat are to absorb Oxygen and produce Alkali; and as the proportions of the ultimate constituents of Woad will be as 4 Hydrogen, 3 Azote, 2 Carbon, 1 Oxygen, (as in the Alkaline stage,) all in a free or uncombined state, and Carbon having a stronger affinity for Oxygen than for any other substance; Hydrogen and Azote being also inclined to unite, the effects of these compound affinities will be to produce, simultaneously, Carbonic Acid and Ammonia; but as the proportion of Carbon exceeds the Oxygen, (in the Woad,) and the Indigo, holding Oxygen by a weaker affinity, gives it up to the Carbon, (creating Carbonic Acid,) the Indigo is deoxydized and will now dissolve in Alkali.

But, 3d. As the Ammonia and Carbonic Acid thus formed must, from their natures, reciprocally neutralize each other, and create a Carbonate of Ammonia, and as deoxydized Indigo will not dissolve in the solution of a neutral salt, it is evident that we must get rid of the Carbonic Acid before we can avail ourselves of the Alkaline properties of the Ammonia as a solvent for the Indigo. To effect this object, we add slacked Lime, (Ware,) which immediately unites to the Carbonic Acid, when both are precipitated as an insoluble Carbonate of Lime—the Ammonia is liberated—and the Indigo dissolves in it.

4th. Although nothing were put into the Vat except Indigo and Woad, it would, in time, assume its functions of deoxydizing and dissolving Indigo: yet, in order to expedite and give greater energy to the fermentation, Madder and Bran are added; which, as they furnish it with considerable saccharine and farinaceous matter may be considered as given for the same reason as Yeast or Barm is added to a solution of Sugar, viz: to start the fermentation of the materials in all their parts at once. In fact, there is nothing like Yeast (or Barm) to raise the fermentation of a Woad Vat, and to impart energy to its materials, when the fermentation lags from over-working and other causes.

Therefore, when a Woad Vat is first put together, in the usual manner, the process commences with the Alcoholic fermentation of the sweet matters in the Madder, Bran and Woad, which deoxydizes the Indigo, and forms Carbonic Acid; while at the same time the Woad yields Ammonia: but as this Acid and Alkali rapidly unite, and form a salt that will not dissolve Indigo, and as at the commencement, the quantity of Carbonic Acid formed is greater than the Ammonia, a portion of Lime becomes necessary to saturate the Carbonic Acid, when the Ammonia, becoming free, dissolves a portion of the Indigo. The process now proceeds as before, when, after awhile, the Carbonic Acid again obtaining the ascendency, another portion of Lime is required; more Ammonia is set free, and some more of the Indigo is dissolved: this alternate waiting for the formation of Carbonic Acid, and serving with Lime, is persevered in, until the production of Acid and Alkali are balanced, and the whole Indigo brought into solution.

But if, at any of these servings with Lime, we should incautiously give too great a quantity, or before the formation of any fresh Carbonic Acid, we throw the Vat back, and arrest the further progress of the operation; in this case we have to give a fresh quantity of Madder and Bran, in order to re-commence the fermentation, or wait until the native vigor of the Woad again urges on the process.

And again, if we neglect to serve it with the Lime at the proper time, then the Carbonic Acid overpowers the volatile Alkali, and if suffered to proceed in this state, the Ammoniacal odor ceases—the Indigo precipitates, and the Vat is in danger.

But when the process of Setting has been properly conducted, the Vat fairly balanced, and all the Indigo brought into solution, then the operation of Dyeing may be commenced.

Yet furthermore, as by Dyeing in the Vat, the liquor gets much exposed to the atmosphere, and in consequence, a quantity of oxygen is absorbed by the Indigo, which imparts it to the Carbon of the Woad, giving rise to a quantity of Carbonic Acid that requires a portion of Lime for its saturation; it therefore becomes necessary to serve with Lime after every day's Coloring.

But if, at any time in daily serving the Vat with Lime, we should overcharge it, the deoxydation of the Indigo ceases—as the surcharge of Ware prevents the further formation of Carbonic Acid—the Ammoniacal smell becomes more caustic; the liquor looks darker colored; the bottom (or Woad) is blackened with the precipitated Indigo, and feels heavier and tougher to rake; and the color it communicates is of a gray and feeble shade; the Vat is now what Dyers term full up with her Ware.

If, by repeated surcharges, it has become so tight or hard that it will not color, (and if it is carried to the greatest excess,) all the Indigo precipitates; the Ammonia has evaporated; the smell is that of new-slacked Lime; the Alkaline fermentation and the production of Carbonic Acid have ceased; and the bottom is black, solid and tough. When a Vat has got into this situation, it is something of a job to neutralize the excess of Lime, and raise again the fermentation.

Again, on the other hand, if we, by negligence or otherwise, in our daily serving of the Vat, leave it short of the necessary quantity of Lime required to saturate the daily production of Carbonic Acid; then, as the mischief progresses, the Ammonia is gradually overpowered; it colors Wool of a pale, sickly, greenish yellow, which does not become a distinct Blue by exposure to the air. The odor of the Vat is at first soft and sweetish, then vapid and flat; the liquor and the sediment are greenish, or light-colored; the bottom is buoyant and loose; the Vat is in an alarming and critical situation, and must be served immediately with Ware, to prevent its passing suddenly into the Putrefactive state of fermentation.

Such is my explanation regarding the phenomena of a Woad Vat, which may be briefly summed up as follows:

1st. That the intention in using Woad, Madder, Bran and Lime in a Vat, is to effect the solution of the Indigo in water.

2d. That the Madder and Bran act as Yeast or Ferment, and excite fermentation.

3d. That the fermentation of Woad is a double operation, producing Carbonic Acid and Ammonia, which, uniting, form Carbonate of Ammonia; while, as the Carbonic Acid forms, the Indigo is deoxydized.

4th. That the Lime decomposes the Carbonate of Ammonia, precipitating the Carbonic Acid and leaving the Ammonia free, when the deoxydized Indigo is dissolved by it.

As the formation of Carbonic Acid is necessary to the deoxydation of the Indigo, and the presence of Ammonia is required for its solution, it is indispensable to precipitate the former, in order to give freedom to the latter; hence, the important part that Lime performs in effecting this object, constitutes it the nice balancer of the Vat, and the great regulator of the Fermentation; and the nicety required in proportioning this article to the quantity of Carbonic Acid formed, makes it the most delicate operation in the Art of Dyeing: for the principle derangements a Woad Vat is subjected to, proceeds from an under or over-charge of Lime.

The quantity of Lime given, must bear such a proportion to the quantity of Carbonic Acid formed, that the two substances will mutually saturate each other, and form a neutral insoluble precipitate of Carbonate of Lime, leaving the Ammonia and Indigo in solution, which situation constitutes the true working condition of the Vat.

I here finish my attempt to give a correct explanation of the difficult and almost inexplicable changes that take place in the Woad Vat. How far I have succeeded, I now leave to Dyers of the highest scientific attainments to decide.

Y

YOUNG FUSTIC.

Young Fustic, Venus' Shumac, or Fustet.—This Dyestuff is chiefly used for Scarlet, to give the yellow tinge peculiar to that color; it is also used for Buffs, Canes, Melons, Nasturtion, Aurora, &c.

It is much better for some of these Colors than any other kind of Yellow Dyestuff, especially where Cochineal is employed; in fact, no other kind of Yellow ought to be employed for Scarlet, as it communicates a much better hue to that Color than anything else will do.

I have seen very little of this article in the United States; it ought to be imported.

It is sufficiently durable to be employed for the above purposes, but is not adapted for making full Yellows, Oranges, or Colors that are very deep, and in which the Yellow prevails very much over the Red part of the Color.

ON THE RELATION BETWEEN THE DYESTUFFS AND THE CHYMICAL COMPOUNDS.

THIS subject is of the utmost importance in Dyeing, both as regards economy in the use of the materials, the results obtained, and the effects produced upon the fabrics to which they are applied; and yet it has never been investigated, noted, or even thought upon, and we are still in the dark as regards the positive quantities of Coloring-matter and Mordant necessary to produce the most desirable effects: we are still pursuing, without any regard to proportions, a business whose economy and execution depend entirely upon a knowledge of the quantities in which its materials combine, and we are yet performing at random, the operations of an Art which requires the nicest distinctions, and demands the greatest regularity, and whose combinations are effected in the proportional numbers of a System.

We have been blundering on from age to age, without paying any attention to so plain a circumstance as the definite combination of the Coloring-principle with the Base of the Salt employed as the Mordant of the Color.

We have proceeded by chance, and without seeming to notice that on adding any of the Chymical compounds to a decoction of any of the Dyestuffs, we come to a point where all the Coloring-matter was precipitated from the liquor, and the addition of any more Mordant was useless, and the quantity of Coloring-principle in the decoction had united to a certain quantity of the Chymical Compound, and could not be made to combine with any more of it.

We de not seem to have considered that this gross quantity of precipitate showed thé net quantities in which the Coloring-matter and the Mordant combine to the mutual saturation of each other, although the inference ought to have led us to the fact, that the Coloring-principle of all Dyestuffs, combines in certain and definite proportions with all Salts capable of forming a Precipitate or Lake with the Coloring-principle, in as positive and determinate a manner as the different metals require different proportions of the several Acids for their saturation; and that there is a Law of Prime

Equivalents, or a Scale of Combining Ratios, according to which the Coloring-principle and the Metallic Salts (or their radicals) enter into combination and reciprocally saturate each other; and that this is a decisive and General Law, which regulates the combinations of all kinds of Dyestuffs, with all kinds of Chymical Compounds or Mordants, and determines the quantity of their Precipitates or Colors.

Hence, we see how necessary it is that the doctrine of Prime Equivalents should be brought into practical operation in the Art of Dyeing; for as the Dyestuffs and the Mordants do naturally combine in determinate and definite quantities only, we should, in forming Colors, take merely that just proportion of each of the constituents necessary to form that definite combination, as any excess of either of them is a loss in the materials, or an injury to the fabric, or both.

What these combining proportions are, we have yet to ascertain, by a series of well conducted experiments, which will necessarily take up too much time, and require greater facilities than a hired Dyer can possibly afford or command. I have, therefore, to regret (through the want of means) my inability to furnish a table of these proportions, at the present.

A table or tables of the above character would be of the greatest importance to the economy of Dyeing.

CHYMICAL COMPOUNDS.

Mordants or Chymical Salts.

SUCH of these substances as I intend to give a description of, in this work, are the following:

The Alkalies.—Ammonia, Urine, Lime, and Soap.

The Acids.—Sulphuric, Nitric, Muriatic.

Salts.—Alum, Super-Tartrate of Potash, Murio-Sulphate of Tin, Nitro-Muriate of Tin, Sulpho-Muriate of Tin, Sulphate of Tin, Sulphate of Iron, Sulphate of Copper, Sulphate of Indigo, Prussiate of Potash, Argol, Crystals of Muriate of Tin, Sub-Carbonate of Soda, Tin, Block Tin, Grain Tin, Prussiate of Iron.

For further particulars respecting these classes of bodies, I advise the reader to consult some of the Chymical writers upon them, as I shall only notice such circumstances connected with these Compounds, as are immediately connected with the operations of Dyeing.

(See "Table of Chymical Compounds or Salts," at the close of this volume.)

THE ALKALIES.

The general characteristics of Alkalies are the following: They are the antagonistic principle to Acids; that is, they destroy or rather neutralize acidity, or anything that is sour. They act in a very caustic and powerful manner upon Wool or Woolen goods, speedily injuring the texture and color, and when a solution of Alkali is very strong and hot, it dissolves Wool and converts it into a sort of soap. The fixed Alkalies,—Soda, Pot, and Pearlash—are more injurious to Wool than the volatile Alkali, or Ammonia.

Alkalies also unite with oils and fats, rendering them soluble in water, and converting them into Soap.

They are very soluble in water; and ought to be used when caustic, (or even when considerably saturated with Carbonic Acid,) with great circumspection; especially upon fine Fabrics.

They are used (in Dyeing operation) chiefly for scouring; as alterants or heighteners of colors; or as solvents for Indigo and other intractible materials. Their effects upon colors are to brown or redden the Yellows, blue up the Reds to Purple, and cause the Purples to become Blue.

The fixed Alkalies are Metallic Oxydes; and the volatile Alkali is composed of Hydrogen and Azote; they all pass to the negative pole of the Galvanic battery. They are a pretty numerous class of bodies, but the only ones we have anything to do with (as Dyers) are Ammonia, Soda, and Potash, as Alkalies proper; Lime, as an Alkaline Earth; and Urine and Soap, as Alkaline Compounds. Their Chymical Compounds, or their relative strength or powers, are in the following order:—Ammonia, 2.125; and Aqueous Ammonia (of the specific gravity of 0.875) contains 32½ per cent. of the above Ammoniacal gas; Lime, (an Alakaline Earth,) 3.5; Soda, 4; Potash, 6; Urine, uncertain, from the variable quantities of Ammonia, Salts, and water, in different specimens. Soaps (the Alkaline compounds of fat;) the hard, white Soaps, contain about 7 per cent. of Soda, the remaining parts fatty matter and Water; and the soft Soaps contain about 9 per cent. of Potash, the remaining parts Water, fatty matters and neutral Salts.

s the Alkalies produce Salts with the different Acids, when they unite together, the above numbers show the quantity of each kind of Alkali required to produce the same effect upon an Acid, or the rate of their combinations with anything else.

Thus, the prime equivalent of Sulphuric Acid being 5, in order to neutralize that quantity of Acid, it will require 2.225 of Ammoniacal gas;—3.5 of Lime;—4 of Soda;—or 6 of Potash; and of Urine or Soap, the quantity will be in proportion to the amount of Alkali contained in them.

AMMONIA.

Ammonia is an elastic and invisible gas, or aeriform fluid; and in this state is sometimes called the Volatile Alkali. It is obtained pure by mixing equal weights of Lime and Muriate Ammonia (Sal Ammoniac,) well powdered, and exposing them to a gentle heat in a retort; when the Lime combines with the Muriatic Acid of the Muriate of Ammonia, and liberates the Ammoniacal gas, which is received into a jar over Mercury for experiments, but is conveyed by a tube into water for the use of the manufactories. In this state it is known as Aqueous Ammonia, Water of Ammonia, or Spirits of Hartshorn.

Water absorbs Ammonia (Ammoniacal Gas) with great rapidity, taking up about one-third of its weight, or 460 times its bulk of the gas, which increases the volume of the Water one-half, and lowers its specific gravity from 1000 to 0.875, and it then holds in solution 32½ per cent of pure Ammonia. The specific gravity of Water of Ammonia ranges from 0.875 to 0.995;—at 0.875 it contains 32½ per cent. of Ammonia, and at 0.995 only 1¼ per cent.

Ammonia and its constituents, enter into the composition of all animal matters, and is given off from them in a state of Carbonate, when they are subjected to destructive distillation. It is evolved from matters undergoing the Alkaline Fermentation. It exists in stale Urine, and is the substance to which that animal secretion owes its scouring properties and its Alkaline qualities.

It is employed in the manufacture of Archil and Cudbear, and is the peculiar odor exhaled from Woad. It is generated during the fermentation of the Woad Vat, and is the Alkali that holds the Indigo in solution in it. Its aqueous combination dissolves the Oxydes of Zinc, Iron, Copper, and Tin; and even Zinc, when in the metallic state. Although possessed of more Alkaline strength than either Soda, Potash, Lime or Potash Soap, yet it does not act with such destructive energy upon Wool or Woolen Fabrics, as any of these do; its elastic or volatile quality carrying it off before it has time to spend all its force upon the animal matter. Its constituents, also, being such as enter into animal substances, may account, in some measure, for its slight action upon them.

It is, therefore, the safest and best Alkali to use for Woolen Fabrics in such processes as require the intervention of any of these articles. Its various combinations, as Urine, &c., carry with them into the processes of Dyeing, all the mild qualities which render the Ammonia itself so safe and effective. Hence arises the superior strength and softness of such Wool or Cloth as has been scoured with Urine, or Dyed in the Woad Vat, over such as have been scoured and dyed, by the employment of any of the other Alkaline articles.

Ammonia is employed for all such purposes in Dyeing as require the presence of an Alkaline principle, and is always the best, because the attenuation of its substance being the greatest, it will consequently produce the finest effect.

SODA.

One of the fixed Alkalies, formerly called Natron, or the Mineral Alkali. It is obtained, directly, by burning the sea weed Solsola Soda, the ashes of which form an impure kind made in the British Islands that goes by the name of Kelp;—this article does not contain more than about 5 to 7 per cent. of real Soda.

There is another kind made in Spain, called Barrilla; this is a better article than the Kelp, and is of greater Alkaline strength.

Impure Soda is found naturally existing in the neighborhood of lakes, in different parts of Africa and other quarters of the world; but the Soda we have about the manufactories is of a much better quality, or rather a purer article, being a Carbonate in the crystalized state, and is made by the decomposition of the Sulphate of Soda.

This Salt is soluble in twice its weight of cold water, and in an equal weight of boiling water. It consists of 15.3 Carbonic Acid; 22 Soda; 62.7 Water of Crystalization=100. In a dry atmosphere, its water of crystalization speedily evaporates, and the Salt falls into a powder; one pound of the powder is as strong as two pounds of the crystals. The Prime equivalent of the dry powder is 6.75; and when crystalized it is 18. Boiled with quick Lime, it is deprived of its Carbonic Acid, and when evaporated dry, it is then pure Soda, whose combining proportion with Acids is 4.

Soda, or its Carbonate, does not act in so caustic a manner upon Wool as Potash or Lime does; it should therefore be employed in preference to Potash or its compounds, whenever necessity compels the use of the fixed Alkalies for scouring and other purposes, through a scarcity of Ammonia or Urine. It is next in beneficial effects to Urine or Ammonia, in the operations of Dyeing, but ought not to be substituted for either of them, except in unavoidable cases.

POTASH AND PEARLASH.

These are sometimes called the Vegetable Alkali to distinguish them from Soda, or the Mineral Alkali; also, Salt of Tartar, &c.; but these names are nearly obsolete, for they only serve to perplex the mind and divert it from their true nature.

Potash is obtained by the burning of wood in the boundless forests of North America, and also in the North of Europe; the ashes are lixivated with water and evaporated in semi-globular iron pots; it is then called Potash. To convert this into Pearlash, it is taken to a furnace where it is subjected to a regulated heat, which further purifies and refines it.

But neither Pearl nor Potash are the Alkali, so called, in a state of purity, they both contain more or less earthy matters and Carbonic Acid;—this crude Alkali is also made by the decomposition of the Sulphate of Potash or Sal-enixon of the Aqua Fortis manurers.

The common Potash of Commerce is a very caustic substance, as every one knows; it is soluble in water in all proportions, and any of these solutions act in a very corrosive manner upon Wool, and however cautiously it may be used in scouring and other operations, it always leaves Woolen goods harsh and disagreeable in their feeling; the colors are also greatly impaired in beauty by using it as a scour for Flannels, and they speedily fade after being subjected to its action, in the process of Scouring. By its great solvent power, it totally destroys the barb of the Wool, and prevents its Fulling so well as it otherwise would do, and the Cloth will never take so high and permanent a steam polish. Its injurious effects upon Woolen fabrics are great and many, and the only way to get rid of them, is to abjure the use of the article that causes them.

The great and almost universal use of Potash or Potash Soap, by American Woolen Factories, for scouring and other purposes, is one of several causes of the inferiority of American Woolen Cloths, compared with those of other nations, manufactured from the same quality of Wool.

This is a mortifying assertion, but it is a glaring fact, and shows that the workmen in this country either lack a knowledge of its nature, or are compelled to use it through the obstinacy and ignorance of their employers.

There is no operation connected with the Woolen Manufacture that requires the use of Potash, except in Dyeing Blue by the Ash Vat, and in this state the quantity of Carbonic Acid, generated by the fermentation of the Madder and Bran, saturates the Alkali and modifies its effects; nevertheless, even in this mild state, it leaves the Wool or Cloth very harsh and brittle, and this kind of a Vat ought never to be used but in cases of extreme necessity, and for the coarsest description of Wool.

The only thing that induces me to say anything respecting this article, is the extensive and improper use made of it in the Manufactories. I therefore caution Dyers not to use it in their processes for Woolen goods; and manufacturers not to have it upon their premises, if they wish to have their goods kind, pliable and soft; and the colors rich and permanent.

I declare it to be an axiom in the Manufacture of Woolen Goods, that Potash cannot come near them, in ever so dilute a solution, without injuring their texture and imparing the beauty of and permanence of the Colors, in some degree.

Potash and Potash Soap are employed through mistaken notions of economy; but avarice always defeats its own intention; and where manufacturers use most of these articles, they are most noted for making bad and rotten Cloths.

If you have much of it in your establishment, the greatest economy is to throw it on the dung-hill, or heave it into the river.

LIME.

This Alkaline Earth is not much employed in Woolen Dyeing, except for the Woad Vat, in whose operation it is of the most vital importance. For this use, the best and purest kind only must be taken, and it must be in a quick or caustic state (if it be air slacked, it will not do.) It is slacked with water, until it falls into a loose and impalpable powder, and before using in the Vat it is well riddled or seived, to separate any stones or other foreign matters from the powder. In this state it is technically known among Dyers as *Ware.*

In this process a real combination between the Lime and the Water takes place, converting the former into a Hydrate; and the latter, in passing to the solid state, parts with its latent caloric (or the Galvanism that preserved it a fluid,) which is the origin of the sensible heat exhibited in slacking Lime.

The Brown or Magnesia Lime stone will not answer for this purpose, nor any other kind than the purest and best.

It takes nearly 100 gallons of Water to dissolve 1 lb. of Lime, but Sugar greatly increases its solubility, as 2 lbs. of Sugar in solution, take up 1 lb. of Lime.

The specific gravity of Lime is 2.3, and its prime equivalent 3.5.

From the little solubility of Lime in Water, it will be seen that this cannot be the *solvent* of Indigo in the Woad Vat; it merely neutralizes the Carbonic Acid, and the Ammonia is the solvent of the Indigo.

URINE.

Human Urine, which is the best and the only kind that ought to be used for Woolen Goods, is, when fresh voided, acid in its properties; but by standing some time, it runs into the Alkaline fermentation and becomes charged with Ammonia, and deposits a sediment of earthy and insoluble Salts.

Urine in this state is the best, and seems the most natural scouring liquor for fabrics made of animal matter; it leaves the texture of the article in a soft and natural state, and does no injury to the Colors: for these reasons it ought always to be employed in those processes of Dyeing and Scouring where an Alkali is indispensable, in preference to every other article.

Ammonia, or rather the Aqueous Ammonia, is the only material that can be substituted for it, with any prospect of success.

In scouring Wool for the Woad Vat, Urine or Ammonia are the only Alkaline matters that should be employed.

The following substances enter into the composition of fresh Urine: Urea, Phosphates of Lime, Magnesia, Soda, and Ammonia; Phosphoric, Lithic, Rosaic, Benzoic and Carbonic Acids; Carbonate of Lime, Muriates of Soda and Ammonia, Gelatin, Albumen, Resin, Sulphur, and Water. Water forms about 900 parts in 1000 of the whole solution.

POTASH SOAP.

This is so fallacious and detestable an article to use on Woolen Goods, that I say no more about, than that it ought to be banished *in toto* from all Woolen Factories.

THE ACIDS

Are a very numerous, interesting, and important class of substances: in this work we shall only describe three of them, as the ones with which the Woolen Dyer has most to do, viz: the Sulphuric, Nitric and Muriatic.

Acids are the antagonist principles to Alkalies; that is, they neutralize Alkalinity and form Salts by their union with them: they combine with the Earths, also; and these compounds are in general soluble, but some of them are not so. They act upon metals, oxydizing, combining with, and dissolving them, thus bringing the Bases of Colors into a tangible form for the Coloring-principle to operate upon them. They modify the shades of colors, turning the Purples to Reds or Orange, and the Red to Orange or Yellow, and make the Yellows, of a brighter, lighter and more Lemon shade.

Thus we see the primary importance of these substances in the Art of Dyeing, and the necessity of their presence in the formation of Colors.

Acids enter into the composition of all the Crystalizable Salts or Chemical Compounds or Mordants named in this treatise, and are the medium of solubility for the greater part of their radicals. They have all a sour taste when diluted with water to a certain degree; they combine with water in almost all proportions; some of them are extremely grateful and refreshing when used as drinks or with food; while others, in ever so small quantities, act on the living body as corrosive and deadly poisons. In a free, or uncombined state, they attack vegetable fibre and injure its strength, even when much diluted with water. In this respect they operate upon vegetable substances, as Alkalies do upon animal matter.

They do not injure wool much, except they be in considerable strength, or aided by a powerful heat, consequently Woolen fabrics bear a greater quantity of Acids without injury than they can do of Alkali; but as they seem to combine some with wool, they therefore retard its fulling and scouring in a slight degree.

The relative strength or the quantities of each of the Acids that we shall here consider, required to saturate an Alkali, or form compounds with an earth or a metallic, are as follows:—Sulphuric

Acid (of specific gravity 1.848) is 5;—Nitric Acid (specific gravity 1.500) is 6.75;—Muriatic Acid (specific gravity 1.200) is 4.60.

Thus 5 of Sulphuric Acid, 6.75 of Nitric and 4.60 of Muriatic Acid, each neutralize 2.125 of Ammoniacal Gas, or 3.36 of water of Ammonia; 4 of Soda, and 6 of Potash.

SULPHURIC ACID.

This Acid, as its name denotes, is a combination of Sulphur and Oxygen, and is commonly called Oil of Vitriol.

It is manufactured by burning Sulphur and about one-eighth its weight of Nitrate of Potash in large Leaden Chambers, on the bottom of which is spread a quantity of Water, which imbibes the Acid fumes and constitutes a weak Acid; this is run off into Glass or Platina vessels, and evaporated to the specific gravity or strength of 1.848, or even heavier; it is now considered as Concentrated Sulphuric Acid, or Oil of Vitriol.

In this state it has a great attraction for moisture, and should be kept carefully covered and corked up: it is a highly corrosive substance, speedily destroying all organized bodies, and converting animal and vegetable matter into charcoal. It is the only liquid that will combine with, and dissolve Indigo, without deoxydizing it, and only then when the Acid is in the highest state of concentration, as the addition of a very little water incapacitates it from dissolving that substance.

It combines very intimately with water, for on mixing these two liquids, a great condensation of the net volumes of the two is the consequence; and one or the other, or both the liquids must pass to a more solid state, as the Electrical equilibrium is disturbed, which is manifested by the sensation of heat; for 4 lbs. of Sulphuric Acid, mixed with one pint of Water, raises the temperature of both, from 60 to 300.

Sulphuric Acid combines with Alkalies, Earths and Metals, and the Salts thus formed are called Sulphates of the particular base to which it is united.

In combination with the Aluminous or Argilaceous Earths, it is known as Alum, or the Sulphate of Alumina, and in union with Lime it forms Gypsum, or the Sulphate of Lime (which is insoluble:) it exists with Copper in Blue Vitriol, which is a Sulphate of Copper; and it forms about one-third the weight of Copperas or Sulphate of Iron.

Oil of Vitriol, or Sulphuric Acid, is used mainly by Woolen Dyers, for making the Sulphate of Indigo, (or Chymic,) and with Muriatic Acid as a solvent of Tin, in making the solution of Murio-Sulphate of Tin, as a Mordant for Scarlet, Yellow, &c.

NITRIC ACID.

This Acid is obtained from Nitre, Salt Petre; (Nitrate of Potash;) to manufacture it, two parts of Nitrate of Potash and one part of Sulphuric Acid are introduced into a proper apparatus, and a gentle distillation commenced, which expels the Nitric Acid, leaving the Sulphuric Acid in combination with the Potash of the Salt Petre, which residuum is known by the common name of Sal-enixon, and by its chymical name of Sulphate of Potash.

Nitric Acid, when pure, is clear and limpid, and in its most concentrated state has a specific gravity of 1.500; in its action upon animal substances, it colors them yellow, and finally disorganizes and converts them into Oxalic Acid.

It acts violently upon Indigo, discharging its color and changing its nature, leaving it yellow, tough and astringent.

In a diluted state, it is employed as a discharge in Woolen Printing; all the vegetable colors being changed to a Yellow by its action.

A very impure Nitric Acid, of the specific gravity of 1.325, is manufactured and sold in the United States, under the name of Double Aqua Fortis, or Nitric Acid; and still more diluted, until its specific gravity is no more than 1.170, it is sold as Single Aqua Fortis to the manufacturers, for the purpose of dissolving Tin, as a Mordant for Scarlet—a purpose that it is no way calculated for.

The Aqua Fortis of the Woolen Dyer is an Aqua Regia, or a Nitro-Muriatic Acid, which is manufactured by a peculiar process.

The proper Aqua Fortis of the Woolen Dyer, is not a simple mixture of the two Acids, but is as distinct from that, as a simple mixture of Alcohol and an Acid is a distinct material from Æther.

But a simple mixture of the two Acids will be far better for the Dyer to depend on, than the spurious article going by the name of Single or Double Aqua Fortis, in the United States.

I shall give directions regarding the simple mixture of the two Acids, when I describe the solutions of Tin; but as Dyers in this country would receive no benefit (or profit) if they knew how to make the real Nitro-Muriatic Acid, or proper Aqua Fortis, I here withhold any information respecting it.

Nitric Acid forms Salts with the Alkalies, Earths, and Metals, and exists in all compounds called Nitrates.

The constituents of Nitric Acid are Azote and Oxygen.

MURIATIC ACID.

This is sometimes called Spirits of Salts, which may lead to mistakes. It can be made from any Salts bearing the name and character of a Muriate; but it is usually manufactured from the Muriate of Soda, (or common Salt,) by treating it with Sulphuric Acid, and receiving the expelled Muriatic Acid Gas into water, in an arrangement of vessels called a Wolf's Apparatus.

In this manner, water will absorb about 480 times its volume of this Gas, by which its bulk will be increased nearly one-half, and its specific gravity will be found to have risen from 1.000 to 1.210, the strength of the pure concentrated Muriatic Acid.

The usual specific gravity of the Muriatic Acid of Commerce, is about 1.160; it has a pale straw color and a strong smell, which proceeds from the escape of the Muriatic Acid Gas; therefore, the bottles or Carboys containing it should be kept well corked.

The chief use made of Muriatic Acid by the Woolen Dyer is as a solvent for Tin; it enters into the composition of the Nitro-Muriate, Muriate and Murio-Sulphate solutions of that metal.

It holds a greater quantity of Tin in solution than any other Acid; hence the propriety of having a certain portion of it present in almost all the solutions of Tin. Its constituents are Chlorine and Hydrogen.

CHYMICAL SALTS OR MORDANTS.

This name is given to any substance capable of taking the crystaline form, and which is composed of an Acid united to some of the Alkaline, Earthy or Metallic Bases. Their variety is almost indefinite, being as numerous as it is possible for all the Acids to form different combinations, in variable proportions, with all the Alkalies, Earths and Metals.

They are either neutral, sub, or super Salts; that is, the Acid and the Base or Radical, are either in the proportions to mutually saturate each other, and form a neutral compound; or the Base is not fully saturated with the Acid, in which case it is a Sub-Salt; or the Acid prevails over the Base, when it is said to be super-saturated with it, and is then a Super-Salt. They are distinguished as the Alkaline, Earthy or Metallic Salts, according as these respective substances form the Base or Radical of the Salt.

Two or more of them are capable of uniting together, and also two Bases can unite to one Acid, or two Acids to one Base, forming compound, triple, &c., Salts. But for particulars respecting this class of bodies, you must consult Chymical works, as it belongs to that Science to describe it, and not to a work on Dyeing; for it is calculated that any one professing to be a Dyer should be so far (at least) acquainted with the nature of Chymical subjects as to understand enough by the generic terms of that Science, to render a minute description of each separate substance unnecessary.

We shall only notice such of these materials as form Mordants or Sadden to Colors in Woolen Dyeing, or are mentioned in connection with Coloring in our present Work.

POTASH-SULPHATE OF ALUMINA;

OR ALUM.

This earthy Salt is very extensively employed in Dyeing, as a Base or Mordant for a great many colors. Super-Tartrate of Potash is generally used with it for this purpose, on Woolen Goods.

In the process of combining Alum and Tartar with Wool, it has been very correctly shown by M. Berthollet, that the Alum unites entirely with the Wool, without any decomposition of the Salt, but that the Super-Tartrate of Potash is deprived of its excess of Acid, which unites with the Alum and the Wool, leaving the neutral Tartrate of Potash in solution, in the preparation liquor. So that a preparation of Alum and Tartar impregnates the Wool with a Salt composed of Sulphuric and Tartaric Acids; Potash and Alumina.

After this preparation, it is advisable to wash off the alumed article, which prevents the bad effects of carrying any uncombined Alum into the Dyeing Bath.

Alum is manufactured in several of the European countries, and in the United States. In England, the principal manufacture of it is at Whitby, in Yorkshire, which for purity cannot be excelled. It is made from an aluminous schistus, or a clay impregnated with Sulphur; this schistus is first burned in a large pile with wood; then lixiviated with water, and the clear part drawn off into kettles or pans and evaporated to a certain strength, when Muriate or Sulphate of Potash, or otherwise Potash, is added to it, when it is suffered to crystalize. When the crystalization is supposed to be complete, the uncrystalizable liquor is run off, and the solid crystals are washed with water and re-dissolved in as little water as will barely dissolve them at a boiling heat.

This concentrated solution is poured, while hot, into tight casks, and suffered to cool and crystalize; in this state it is usually called Rock Alum.

One pound of Alum is soluble in 12 ounces of boiling water; but it takes 16 lbs. of cold water to dissolve the same quantity.

The specific gravity of its hot concentrated solution is 1.490; at 60 degrees it is 1.0465, and of the Alum itself 1.700. Its composition is, in 100 parts: Sulphuric Acid 34.33; Alumina 10.86; Potash 9.81; Water 45.—BERZELIUS. And its Prime Equivalent is 60.875.

SUPER-TARTRATE OF POTASH.

OR CREAM OF TARTAR.

This substance is of very general application in Woolen Dyeing, as an auxiliary to the Mordants, but is more especially used along with Alum and the solutions of Tin; it is of great use in softening the action of those substances upon woolen fibre, rendering the colors more even and permanent, and modifying their shade by the peculiar effect of its acid upon them.

The action of this acidulous salt with the Mordants, results (in general) in the decomposition of the Tartar; its excess of acid uniting to the metallic or earthy Salt, leaving the remaining part in the state of a neutral Tartrate of Potash.

Cream of Tartar, the acidulous Tartrate of Potash, or Super-Tartrate of Potash, is obtained by treating Argol or the Crude Super-Tartrate of Potash with Clay and Charcoal, and repeated crystalizations.

Thus purified it is a beautiful white crystal, acid to the taste and purgative and cooling to the human system; Dyers sometimes make use of it for that purpose.

Cream of Tartar is of but slight solubility in water, as it takes sixty times its weight of cold water to dissolve it, and fifteen times its weight of boiling hot water to do it; but one fifth its weight of Borax makes it very soluble: Alum also increases its solubility.

The specific gravity of the salt is 1.95; its composition according to Berzelius, is Tartaric acid 70.45; Potash 24.8; water 4.75 in 100 parts. Its Prime equivalent is 24, or more correctly 23.825.

SOLUTIONS OF TIN.

OBSERVATIONS ON THE MAKING OF.

In making these solutions, I advise (as a general rule) to have the Tin well granulated and of the best quality; to add this only in small portions at a time, so that its dissolution may be effected in a gentle and proper manner, and with as little disengagement of acid gas as possible, and to keep the solution during the dissolution of the metal at as low a temperature as is compatible with the combination of the Acids and the Tin. These observations apply with the greatest force in making the solution of Nitro-Muriate of Tin.

SULPHATE OF TIN.

Sulphuric Acid at a boiling heat takes up nearly half its weight in Tin. Or if an equal quantity in weight of water and Sulphuric Acid be mixed together, the mixture rises to 300 degrees of heat, and Tin will dissolve in it with considerable facility, but as the heat subsides, the action ceases, and on mixing either of these solutions with water, the greater part of the Tin falls down in an oxyde, and a portion of the Acid has been decomposed.

Sulphuric Acid is therefore not proper for the direct solution of Tin.

On filtering either of the above solutions (after the oxyde has separated) and then evaporating at a gentle heat, a small quantity of Crystals are obtained, highly charged with acid.

I make the solution of Sulphate of Tin by taking three parts by weight of a concentrated solution of Muriate of Tin and two parts of Sulphuric Acid, to which has been added two parts of water, mixing these together and applying heat until all the Muriatic Acid is expelled. This solution of Sulphate of Tin may be evaporated till it becomes almost a semi-solid, and yet it will not Crystalize; in this state its specific gravity is much greater than concentrated Sulphuric Acid.

I have never been able to crystalize it; I consider it in its most concentrated state as an uncrystalizable Bi-Sulphate of Per-Oxyde of Tin, and to consist of 2 primes Acid; 1 Tin; and 2 water: or 10 Acid; 7.350 Tin; 2.250 water. Its prime equivalent 19.60.

I do not know of any Dyer who is acquainted with this article, nor any person who so makes it.

I find it remarkably effective for some particular purposes.

NITRATE OF TIN.

Nitric Acid in a certain state of dilution and by careful management will make a solution of a specific quantity of Tin, but as this is neither fit for the purpose of Dyeing nor used for such a purpose by Dyers, it is useless to describe the tedious method of making it.

MURIATE OF TIN.

Muriatic Acid will dissolve about one-half its weight of Tin, which it attacks with considerable activity, disengaging a quantity of mixed gases in which Hydrogen may be plainly distinguished.

To make this, take two parts by weight of Muriatic Acid of specific gravity 1.210; reduce it by the addition of cold water to 1.170; then serve it, as directed, with one part of Tin. After this is dissolved, and has got a few days' age, it will have an agreeable and fragrant smell, and a sparkling, glistening appearance, which is owing to a portion of it having crystalized, and the crystals are floating in the solution.

On evaporating this solution by a gentle heat, the water of the solution is driven off, and by cooling, the whole crystalizes, and the mass is then called

CRYSTALS OF TIN,

Or Crystalized Muriate of Tin, which must be kept in well stopped stone jars, to prevent them liquifying, as they are a deliquescent Salt, and attract moisture from the atmosphere, and dissolve in it.

MURIO-SULPHATE OF TIN.

Take two parts by weight of Muriatic Acid, specific gravity 1.210, and one part of Sulphuric Acid of 1.848; add an equal weight of water to this last, and when it has cooled, (from the heat raised by the mixture,) mix the two Acids, and give (gradually) one part of Tin, first reducing the mixture of the two Acids to the specific gravity of 1.200.

This solution also smells fragrant and agreeable; looks glistening and crystalizes like the Muriate. This answers well for Yellows, &c.

ANOTHER MURIO-SULPHATE, FOR LAC, &c.

Take five parts Muriatic Acid, one part Sulphuric Acid, and one part of Tin, (all by weight,) and treat it exactly as described in the preceding solution.

NITRO-MURIATE OF TIN.

A mixture of these two Acids will dissolve nearly one-half its weight of Tin; but it is very rare that such a saturated solution is required, and it is usual always in making this solution, to have an excess of Acid.

Take four parts by weight of Nitric Acid, (specific gravity 1.500,) and three parts Muriatic Acid, (specific gravity 1.210,) mix these together and add water until the specific gravity descends to 1.140, then add one part of Tin.

This solution ought to show a fine opalous amber-yellow color, to be in the greatest perfection for coloring Scarlet shades; but for Yellows, Crimson shades, &c., it will do if it be of a browner Yellow color, and be more highly charged with Tin.

All these solutions of Tin are better to have a little age before using them, especially those where the Muriatic Acid is the principal solvent; the proportional parts named are all by weight.

The slower the Tin dissolves, the more permanent the solution, and the brighter the Colors. The solution of Nitro-Muriate of Tin is uncrystalizable.

SULPHATE OF IRON.

This is the Pro-Sulphate of Iron, Green Vitriol, or Copperas, which is of such general use in Woolen Dyeing as a Sadden or Mordant for all colors that have any darkening, or Bronze in their composition;—its principal consumption is for Black.

This Salt is manufactured from a native Sulphuret of Iron, of which there are great quantities in some parts of the United States, where it composes the principal part of the rocks of whole districts.

In England, it is made from Iron Pyrites, which are found in globular masses in the coal strata;—for making the Copperas, a quantity of these Pyrites are piled upon an inclined platform, and sprinkled with water, from time to time, and as this drains through them, it carries off a part of their substance, which has been rendered soluble by the action of the atmosphere having oxydized the Sulphuret and converted it into an Acidulous Sulphate; these drainings are received into large stone cisterns, and pumped from thence into leaden pans, where a fire is kept up under them for several days, during which time quantities of old Iron have been thrown in to saturate the excess of acid, and precipitate any Per-Sulphate that may have formed.

When this solution is sufficiently concentrated, it is drawn out into stone cisterns, where it cools and crystalizes.

In this state it has a light green color, and is the Proto-Sulphate of Iron; but in time, by exposure to the air, it attracts Oxygen, and is partially converted into the yellow or red Per-Sulphate;—it also, in a dry atmosphere, effloresces and parts with its water of crystalization, and is then a dry powder; and on being dissolved again in water, it is found to be composed of the Per-Sulphate and the Proto-Sulphate of Iron.

When Copperas is fresh and green, it is then in the best state for deoxydizing the Indigo in the Copperas Vat of the Cotton Dyer; but when it is older, or has been further oxydized, so as to appear brown or yellow, it is then better adapted for Dyeing Black, than when fresh and green.

Green Copperas is very soluble in water; 12 ounces of boiling water dissolve 1 lb. of it, and cold water dissolves half of its weight.

The specific gravity of its concentrated solution is 1.754, and of the Salt itself 1.850. According to Berzelius, it is composed of 28.3 of Proto-Oxyde of Iron;—28.9 Sulphuric Acid;—45 Water, in 100 parts. Its prime Equivalent is 21.875.

SULPHATE OF COPPER.

This is the Bi-Sulphate of Copper, Roman Vitriol, or Blue Vitriol. It is of some use in Woolen Dyeing, as a Sadden or Mordant for some of the dark colors, but its principal consumption is as a preparation for Dyeing Black Cloth.

It is manufactured from the Sulphuret of Copper, which is found native in several parts of the world ; it is an ore of Copper called Copper Pyrites. This Sulphuret is roasted, moistened with water, and treated something similar to the Martial Pyrites, in the manufacture of Copperas.

It comports itself in blue crystals, which are soluble in three times their weight of cold water, and they are composed of 31.38 parts of Sulphuric Acid; 32.32 of Oxyde of Copper; and 36.30 of Water, in 100.

Their specific gravity is 2.232, and that of its hot saturated solution is 1.493, and cold 1.308. Its Prime Equivalent is 31.250. The Blue Crystals effloresce in a dry air.

SULPHATE OF INDIGO.

This article has been described among the Dyestuffs; but for further information respecting some peculiar products obtainable from it, called by their discover (Dr. Ure) Cerulin and Phenecin, I refer you to the notes on Berthollet's Elements of Dyeing.

These substances are not applicable to Dyeing in their separate or isolated state.

PRUSSIATE OF POTASH.

Ferro-Prussiate of Potash, or Deutoferro-Prussiate of Potash, contains the coloring-principle of Prussian Blue in combination with Potash.

This article is now so much used in producing the beautiful

Blue on Woolen Goods known as the Prussian or Royal Blue, that a description of its Chymical constitution becomes necessary in a treatise on Dyeing materials.

It is manufactured by the calcination of animal matters with Potash;—the lixiviation of the compound, and its subsequent crystalization.

The crystals of Prussiate of Potash are of a fine yellow color, and have a specific gravity of 1.830; they are soluble in about three times their own weight of cold water, and in an equal weight of water at 212 degrees.

Its composition proportions are 44.53 Prussic or Ferro-Chyazic Acid;—40.34 Potash; 15.13 Water, in 100 parts; or it consists of 1 prime Acid;—1 Potash;—and 2 Water; which equal Acid 6.625;—Potash 6;—Water 2.250; making its Prime Equivalent 14.875.

ARGOL.

Argol, Brown Tartar, or Crude Super-Tartrate of Potash, is deposited upon the sides of casks in which some kinds of Wine are kept, carrying into its crystalization some of the coloring-matter of the peculiar kind of Wine from which it was deposited: hence, some Argols are more or less colored, according as the Wine from which it had separated was more or less tinctured with the coloring-matter.

The Wine, after this separation has taken place, is less colored, and not so tart to the taste.

This crude Tartar is employed by Dyers in all common and dark colors where a Super-Tartrate of Potash is required as an auxiliary to the Mordant;—as it comes at a cheaper rate than the purified and white Cream of Tartar; which is obtained from this Red Tartar or Argol, by precipitating or retaining its Coloring-matter with Charcoal, Clay, &c.

There is no difference in the properties of Crude Super-Tartrate of Potash (which is Argol or Red Tartar) and the white Cream of Tartar, further than what is occasioned by the nature and quantity of coloring-matter it contains.

These properties and constitutions have been described under the heading of "Super-Tartrate of Potash."

PRUSSIAN BLUE.

Or Ferro-Prussiate of Iron.—When any of the stronger Acids are added to a solution of Prussiate or Ferro-Prussiate of Potash, and the heat be gradually raised, the solution grows turbid, and as the temperature increases, the deposit which is forming, attaches itself to Woolen fibre, and gives it a greenish blue appearance. This is the Proto-Prussiate of Iron, and some Potash which has been separated from the Salt of Prussiate of Potash;—on the addition of more Acid, and on bringing the Dyeing liquor to a boil, the color becomes more highly oxydized, and of a clear Blue, to which Dyers give the name of Royal Blue; it is Deuto-Prussiate of Iron, and equals in weight about one-third of the Prussiate of Potash employed.

This is the composition of the Dyer's Prussian Blue, when applied to Woolen Goods; from which the nature of the process of Dyeing the Royal Blue may be gathered; but the Prussian Blue of the Painter, or the article known as Prussian Blue Pigment, is a different thing. To make this, Alum and a highly oxydized solution of Iron are decomposed by the Prussiate of Potash, and the deep-colored precipitate of Prussian Blue is run into molds and dried. This is the Trito-Prussiate of Iron, and it cannot be applied to Woolen Goods as a Dye.

The composition of the Dyer's Blue, or the Deuto-ferro-Prussiate of Iron, is, Acid 6.625; — Deutoxyde 7.250;—Water 2.250; and its Prime Equivalent 16.125.

The Prussian Blue of the Painters, or the Trito-ferro-Prussiate of Iron, is Acid 6.625;—Tritoxyde 10;—Water 2.250; and its Prime Equivalent 18.875.

The Proto-ferro-Prussiate of Iron, or the white-colored Precipitate which first falls on adding the Acid to the Prussiate of Potash, is composed of Acid 6.625.—Protoxyde 4.5;—Water 1.125;—its Prime Equivalent 12.250.

When any strong Acid is added to a boiling hot solution of the Ferro-Prussiate of Potash, a portion of Prussic Acid Gas is expelled, which is very sensible to the smell, while dyeing the Royal

Blue; it also affects the organs of taste;—the lungs are affected; it causes sneezing, and sometimes the Dyer falls sick through its effects. Therefore, considerable caution ought to be taken to preserve the health of the workmen, when engaged on this Color.

If strong Sulphuric Acid be mixed with powdered Prussian Blue, the latter is deprived of its Color; but by absorption of moisture, it returns to Blue again.

Muriatic Acid makes a syrupy solution of it, but the Prussiate separates, on the addition of much Water.

SUB-CARBONATE OF SODA.

For this material, see article Soda.

TIN.

To have a pure and first rate metal, is of the utmost importance in making the Solutions of Tin.

This metal is of a bluish white color and shining appearance; and when good crackles with a sharp sound on being bent, and has a peculiar smell; and it dissolves entirely in Nitro-Muriatic Acid, without leaving any dark colored sediment, if it be pure.

It has a specific gravity of 7.298, and its melting point is 442 degrees; its Prime Equivalent is 7.353.

Tin is distinguished into Common Tin; Block Tin; and Grain Tin.

The first is merely Tinned Iron Plates, and is used for the manufacture of Tin-ware;—the second, or Block Tin, is that kind which is used for making kettles or boilers for Dyeing in, &c.;—the third sort, or Grain Tin, is the purest and best, and is the quality that is used by the Dyer in making his solutions of Tin for coloring Scarlet, &c.

The Cornish Tin of England is the best, and comes either in Ingots, having a crystaline grain, or in small, slender bars.

THIS WORK.

umn oposite each other article. Thus for instance, if we add to any solution containing 31.250 parts of Blue Vitriol, 3.5 parts of Lime, we shall precipitate the whole Blue Vitriol from the solution, because the quantity of Lime given is equivalent or adequate to neutralize the Sulphuric Acid in the Blue Vitriol, which Acid and Alkaline earth forming an insoluble Salt, fall of course to the bottom, as does also the oxyde of Copper that constituted the Base of the Blue Vitriol.

Therefore, when we wish to produce definite effects of any kind, we must take Equivalent numbers to do it.

IS WORK.

ty	Times its Weight of Water to Dissolve it.	Specific Gravity of the Saturated Solution.	Prime Equivalent.
	Water absorbs 460 vol. of Ammoniacal Gas	0.875	3.36.
	Very Soluble		4.00
	" "		6.00
d.	760	1.002	3.5
	In all proportions		Variable
1.			
S	n any quantity	1.848	5.00
Ni	every quantity	1.500	6.75
Mu	Water absorbs 480 vol. f Muriatic Acid Gas	1.210	4.60
Pot	16—hot 13-16.	Cold 1.031—hot 1.496.	60.875
Sup	60 " 15.00	1.032 1.130	23.825
Bi-S	very variety	2.— 2.—	19.600
Nitr	"		
Mur s.)	Soluble		
Muri	"		
Nitro .)	stalizable		
Proto	00—hot 12-16	1.283 1.300	21.875
Bi-Su	90—hot 1½	1.308 1.493	31.250
Sulph .749		1.749	6.250
Ferro-	0 " 1.00	1.207 1.415	13.874—(13.125, Ure.)
Ferro-		0	18.875

This book should be returned to the Library on or before the last date stamped below.

A fine is incurred by retaining it beyond the specified time.

Please return promptly.

Chem 7608.61
The art of dyeing all colors on raw
Cabot Science 003417020
3 2044 091 947 960